PUBLIC WORKS

CITY COUNTY STATE

AUGUST, 1927

VOL. 58 No. 8

Entered as second-class matter at the Post Office, at New York, N. Y., Sept. 1, 1922, under the Act of March 3, 1879.
Published monthly by PUBLIC WORKS JOURNAL CORPORATION, 243 West 39th Street, New York, N. Y.
Subscription price $3.00 a year, single copies 35 cents
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CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 58 August, 1927 No. 8

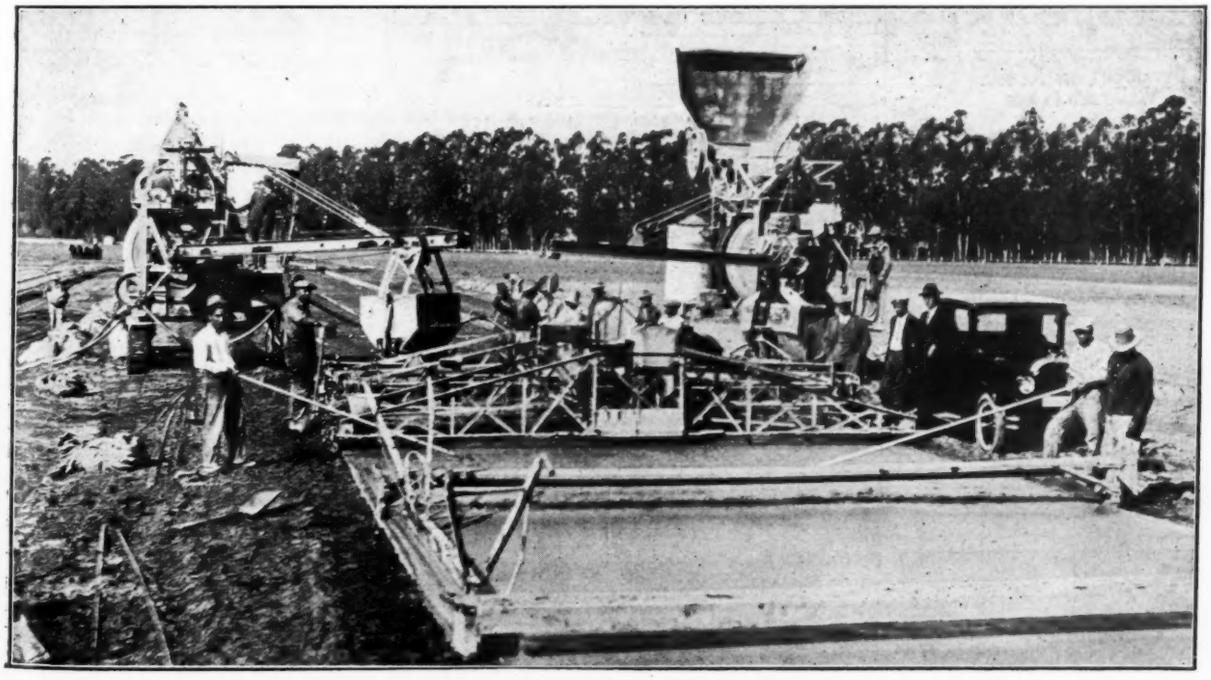
The Oxnard Experimental Pavement

Five miles of concrete pavement carrying heavy traffic built with variations in reinforcement and transverse joint spacing, and of two thicknesses, in various combinations in thirty-eight sections

There was completed a few weeks ago a concrete pavement about five miles long in Ventura county, California, between Oxnard and the coast, which was used by the State Highway Department as an experimental pavement, chiefly for testing the relative effectiveness of different systems of steel reinforcing and methods of placing same, and of transverse joint spacing. The flat grades and straight alignment, with no breaks in the continuity of the pavement, and the almost uniform sandy soil subgrade, presented an ideal opportunity for such a test.

Unlike the test roads at Pittsburg, Cal. and Arlington, Va., this pavement has been built for practical every day use by heavy road traffic. In the general construction of the pavement there was no radical departure from accepted practice, and it is expected that the entire road will give excellent service, but that the differences in details will be reflected in the action of the different sections under traffic.

Two typical sections, known as A and B, the former with a center thickness of 6 inches and the latter 7 inches, were used. A center joint is carried the full length of the road. Expansion joints were placed



DOUBLE MIXER METHOD OF LAYING PAVEMENT

at intervals of 50 ft. with weakened planes 25 ft. from them; and at intervals of 60 ft. with weakened planes 20 ft. apart; and 50 ft. apart without intermediate weakened planes. Reinforcement consisted of each edge reinforced with 2½ in. square deformed bars, with and without slab reinforced with mesh or with bars; or with 1¾ in. square deformed bars; with and without slab reinforced with mesh or with bars. These several details were combined in various ways in 38 different sections, each 1200 feet long except the four end ones. The pavement was described in "California Highways" by A. D. Griffin, resident engineer, Division VII, as follows:

The pavement changed every 1200 feet, except for two longer sections at the beginning and end of the contract. Arrangement of the different sections is such that any effects due to possible variations in quality of the subgrade, or a heavier traffic in one direction than in the other, will balance one another, when the results for the entire five miles are combined and compared.

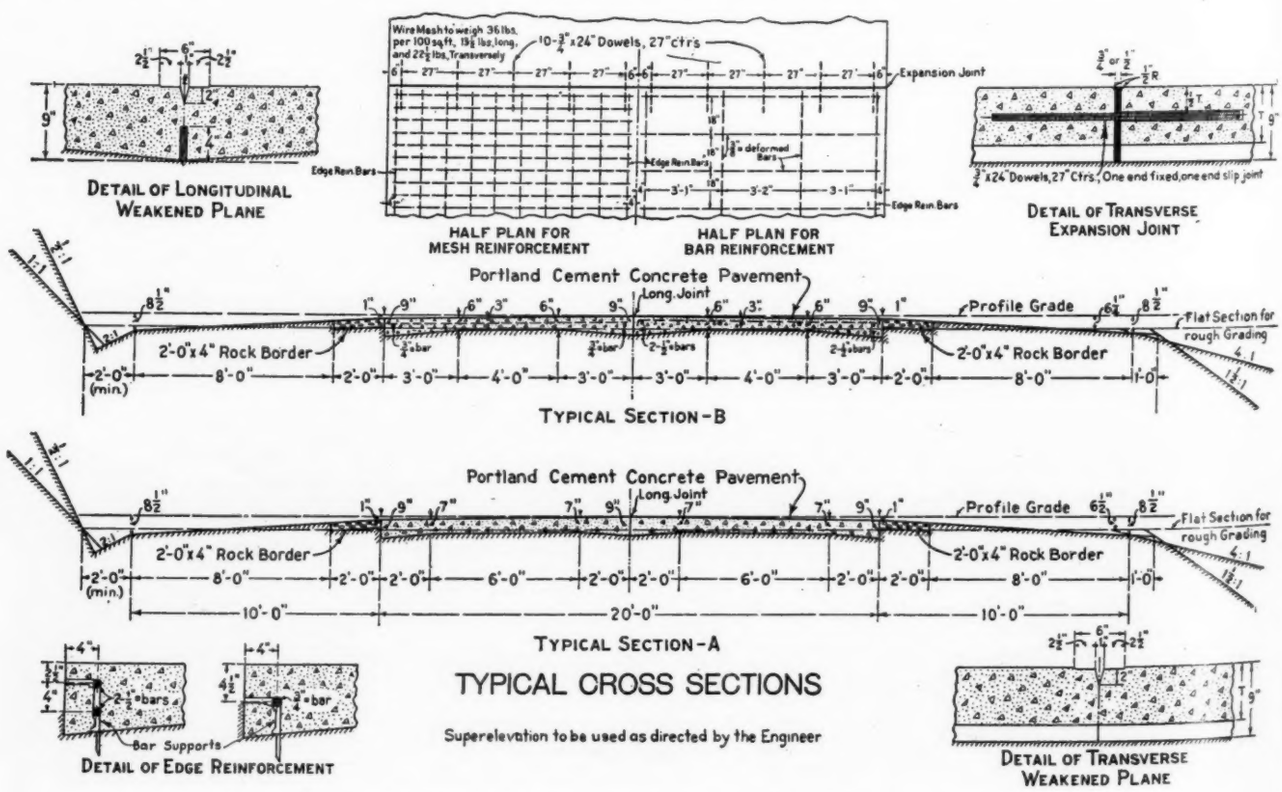
The centerline V-groove under which is placed a submerged wood strip and the transverse dowelled expansion joints, as used on this contract, are now standard California practice. The weakened plane transverse joints, to afford relief for tensile stresses by encouraging and localizing contraction cracking, are a new procedure, although a development of the same idea has been used by the city of Seattle. The concrete mix was all standard Class "A," six sacks of cement to the cubic yard, except for a short section which is subsequently described.

To guard against corner cracking where longitudinal edge and center bars were specified, the same type of reinforcing was carried transversely across the slab parallel to all expansion joints, except where slab reinforcement was used, when the precaution was considered unnecessary. A break in the longitudinal steel was always provided at all transverse expansion and weakened plane joints; no steel passed through the joints except the ¾ in. x 24 in steel dowels. These were placed with slip-sleeves on one end to provide space for expansion. Ten dowels were used in each of the expansion joints, and four dowels in each of the weakened planes. In the latter instance the dowels were spaced 6 in. from the edges and center of the pavement. Dowels were held firm by wiring them to steel pins, ½ in. x 12 in., which were driven into the subgrade as supports. Placing of dowels was given particular attention throughout the project.

CONTRACTOR'S CONSTRUCTION PROGRAM

N. L. Basich and R. H. Richards, who represented the contractor, the United Concrete Pipe and Construction Company, appreciated the fact that the contract was unique in its variety of exacting requirements. They realized also the disadvantages of the usual method of hauling concrete paving materials and of conducting mixing operations on a subgrade composed of the prevailing sandy oil. Earth structures, 10 feet in width, had been planned for either side of the 20-foot pavement, which permitted two 5-sack mixers to be operated opposite each other, and entirely outside the pavement side forms.

Pneumatic-tired dump trucks delivered proportioned batches of rock and sand from the Saticoy Rock Company. All traffic was kept entirely off the



TYPICAL CROSS-SECTIONS USED ON OXNARD EXPERIMENTAL PAVEMENT

USING TWO TAMPERS FOR FINISHING PAVEMENT

subgrade, the hauling being done either along the shoulders or in the side ditches.

This arrangement made possible the lining up of pavement steel and transverse joints well in advance of the placing of the concrete. It also diminished confusion around the mixers and made for better progress. To further speed up operations, the contractor provided two Lakewood tampers which worked in conjunction with one another, except for short periods when repairs were necessary.

When weakened plane joints were being placed, nine finishers were required to take care of a normal day's run. Adverse weather conditions prevented any record of exceptional progress on the job as a whole, but on many days over 400 cubic yards of pavement were placed. This is better than 900 linear feet.

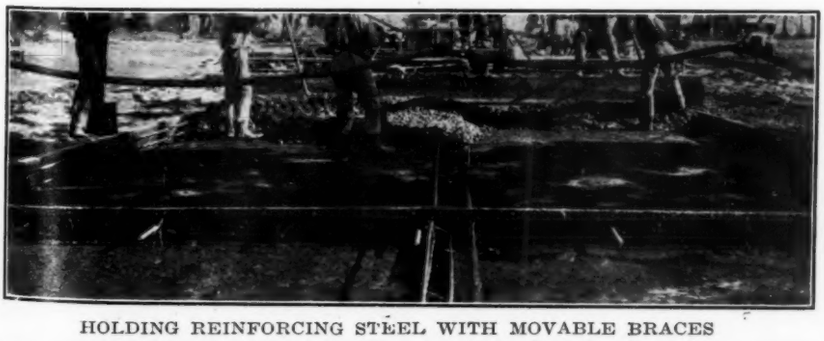
STEEL REINFORCEMENT

Three methods were used for the support of longitudinal steel bars in the pavement slab:

(1) ½ in. x 12 in. steel pins which were driven into the subgrade and to which the longitudinal bars were wired:

(2) Movable braces, an invention of the contractor, which were taken out after the concrete had been spread and which were then reset;

(3) Stiff No. 8- or No. 10-gauge wire supports, bent and welded with stop bars and hooks, which were driven into the subgrade and the headers and left permanently in place.



HOLDING REINFORCING STEEL WITH MOVABLE BRACES

HOLDING STEEL WITH SPECIALLY FABRICATED WIRE SUPPORTS

The last mentioned method proved by far the most satisfactory. The wire supports made possible setting of the reinforcing well in advance of placing of concrete. The bars were held firmly in place not only vertically and horizontally, but also longitudinally which is particularly important where breaks in the reinforcing steel must be accurately spaced for weakened plane transverse joints. The wire supports when left in place also insured against movement of the reinforcing steel during tamping operations. All other methods of steel support have obvious disadvantages.

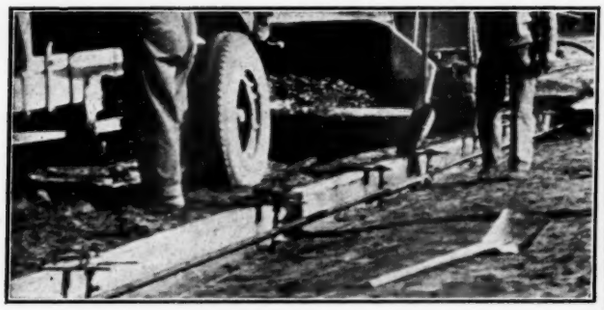
When slab reinforcement was accomplished with

STEEL REINFORCING BARS HELD BY STEEL PINS

wire mesh or ⅜ in. steel square deformed bars, the procedure was as follows:

A layer of concrete was struck off with a template at the depth at which the reinforcement was to go for the full distance between expansion joints. The wire mesh sheets or the previously made up mats of steel bars were then placed and wired to position. The mixers were moved back and the top layer of concrete was deposited, tamped, and finished in the usual manner.

Of the various methods tried other than the use of wire supports, the placing of the concrete mix in two layers appeared to give the best results from the standpoint of getting and holding the steel in its proper place. To meet objections to this procedure, dusty side roads were sprinkled, the first course of concrete on hot days was run slightly wetter, and burlap mats were provided on which



HALF-INCH STEEL REINFORCING BARS HELD IN PLACE BY STEEL WICKETS

workmen wiped their feet to avoid tracking dirt onto bottom course of freshly laid concrete while placing the steel.

WEAKENED PLANE TRANSVERSE JOINTS

Considerable difficulty was experienced in the construction of transverse weakened plane joints. The special provision of the contract showed the transverse V-groove to be the same as the longitudinal center-line V-grove. An effort to follow this requirement indictated that the resulting transverse joint would not be smooth; a clean-cut V-groove by this method seemed impossible of construction without making an objectionable depression.

A method developed by Resident Engineer E. B. Brown, of Division V, for shoulder construction, was enlarged upon and was finally adopted for full width pavement. Under this plan the V-groove tamper was impressed in the concrete after the heavy longitudinal float had passed. In this groove a ¼" x 1½" x 19' 10" steel plate, bent to roadway crown, tapered, and drilled with holes near the top to facilitate pulling, was placed about ¼" below the surface of the concrete. Longitudinal floating was then carried on until the pavement over the plate was as smooth as elsewhere. After the concrete had dried out sufficiently, an edger was run along both

IMPRESSING V-GROOVE TAMPER FOR A TRANSVERSE WEAKENED-PLANE JOINT

sides of the plate, giving it the appearance of an expansion joint. After about four hours the concrete was generally hard enough for the plate to be

SUBMERGING ¼" x 1½" x 19' 10" STEEL PLATE
Finishing carried on over top of plate

pulled and used over again. Great care had to be taken to keep the plates scrupulously clean and well oiled, as otherwise corners would be broken off in the pulling.

PLACING SLAB REINFORCEMENT BY TWO-COURSE METHOD
Wire mesh on one side, ⅜-inch square deformed bars on the other

FINISHING TRANSVERSE EXPANSION AND WEAKENED PLANE JOINTS
Joints 20 feet apart

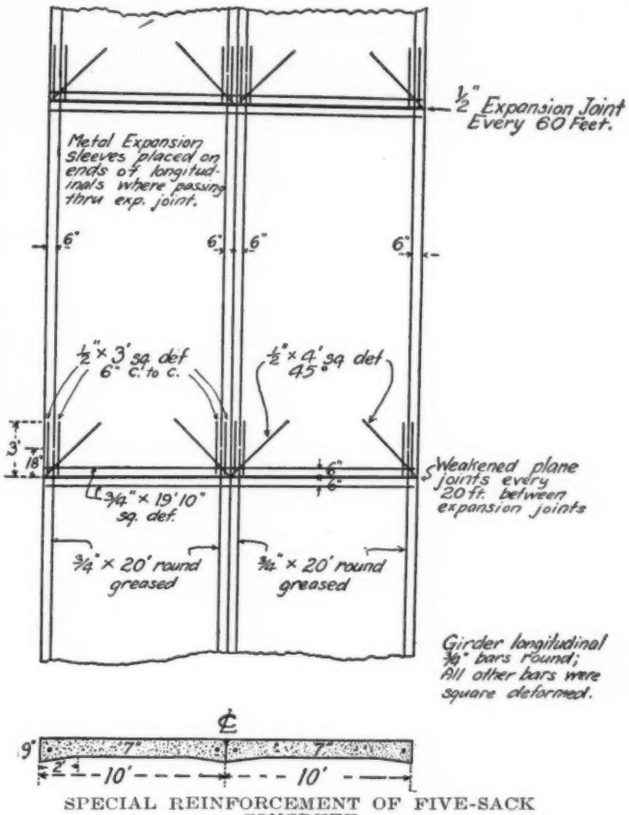
DEPARTURES FROM PRESCRIBED DESIGNS

Between Station 22+60 and Station 25+00, a part of typical section "A," the Construction Department directed that the concrete be poured five sacks to the cubic yard instead of six. Special reinforcement also was used as shown by the accompanying sketch. The ¾" smooth round longitudinal bars used on this section were greased in an effort to cause them to act as dowels over their entire length. Subsequent comparisons of this section with other sections which contain ¾" square deformed longitudinal bars, should determine whether or not the bonding of steel to concrete for the transference of tensile stresses is of as much importance as the dowelling action, in the absence of a bond between the two. This section should also prove or disprove the advisability of providing against corner breaking by placing bars at 45-degree angles.

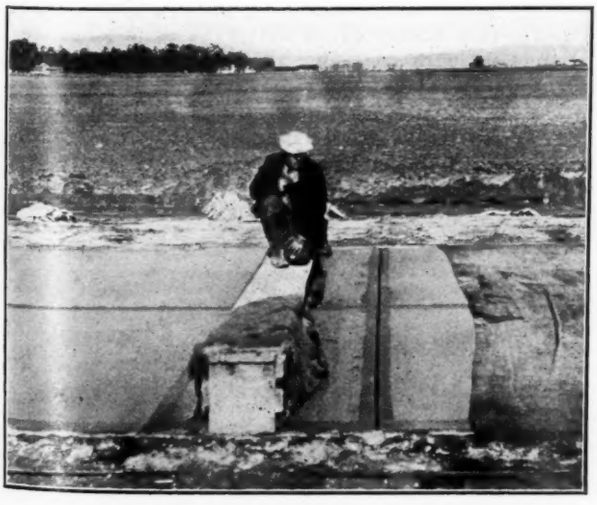
From Station 37+50 to Station 39+50 poor local drainage conditions decreased the bearing power of the subgrade. To overcome this condition an additional inch in the thickness of the concrete slab and additional steel were authorized. This consisted of deformed longitudinal bars ¾" square placed at the edge and center in the southwesterly half of the pavement and also standard reinforcement of ⅜" bars placed on both sides two inches from the top of the slab.

On the three northerly sections containing slab reinforcement, Station 42+00 to Station 54+00, Station 66+00 to Station 78+00, and Station 90+00 to Station 102+00, the steel was placed two inches from the top instead of three inches as originally designed. This change was authorized because it was thought that, by being placed nearer the top, the reinforcement might be more effective in taking up tensile temperature stresses and the flexural stresses of heavy concentrated traffic loads. After the highway has been in use, comparison of these sections with the three where the steel is in the center of the slab should be of interest.

Because of high alkali content in the soil from Station 226+00 to Station 256+00, the completed



SPECIAL REINFORCEMENT OF FIVE-SACK CONCRETE



COMPLETED TRANSVERSE WEAKENED-PLANE JOINT AFTER EDGING AND PULLING OF PLATE

subgrade was given two applications of asphaltic road oil to secure an insulating membrane under the pavement. The first application was of oil with a 40 to 50 per cent. asphaltic content, one quart to the square yard of subgrade; the second application was 80 to 90 per cent. asphalt, in the same amount per yard. This oil treatment was also considered a protection against the shrinking and expansion of the subgrade; and, for this reason, a sand cushion between the subgrade and the pavement, which would otherwise have been placed on the northern half of this section, was eliminated. The soil was of an adobe nature having a linear shrinkage of from 5 to 8 per cent.

Station 199+00 to Station 210+00 was the first section constructed in which slab steel reinforcing was used. While building this unit the contractor was permitted to do some experimenting in the placing of the steel. For this reason the reinforcement on this section is more likely to be defectively placed than that used elsewhere on the project.

Except as above outlined, no other deviations were made in the original plans, nor do any further con-

ditions come to mind which would seriously affect any conclusion which may be drawn from subsequent studies and comparisons of the various types of pavement design. As time goes on, it is hoped that these experiments may settle some of the moot questions regarding pavement design, steel reinforcement, and transverse joint spacing, which have not been as yet satisfactorily or conclusively answered.

Inspection parties who may go over this contract should have no trouble in picking up stations or in identifying the various sections, even without a copy of the layout plans. A different transverse joint spacing often marks a point of change in design. The contractor's stamp, placed at the beginning and the end of each day's run, also carries the station and the date. At points of change of design, the station number has been branded on either side of the expansion joint near the edge of the pavement.

Beside the state engineers, representatives of the steel companies and of the cement associations, city and county engineers, were frequent observers on this contract and valuable suggestions were received from these sources. A. D. Griffin, as resident engineer, was in general charge for Division VII. The inspection work was done by the following assistant resident engineers; W. I. Templeton, T. A. Rosebury, E. W. Taylor, O. W. Monroe, B. T. Thomas and J. P. McAndrew.

For the illustrations presented herewith we are indebted to Mr. Griffin and S. V. Cortelyou, division engineer.

Sanitary Engineering Problems of the Mississippi Flood

Supplying refugee camps with food, medical supplies and safe drinking water, and arranging for construction and proper use of latrines and observance of sanitary regulations. Making water supplies and cities generally safe for return of citizens as water recedes.

By W. H. Weir*

The Battle of the Mississippi is an unending fight. The 1927 flood was one of the river's periodic offensives and its mightiest attempt to regain the area which has been wrested from it by man in his quest for the fertile soil. Every newspaper in the country has told at length of the unprecedented toll of property and life that it has taken. But the life toll will be multiplied many times by the aftermath of the flood unless the sanitarians wage a successful fight against typhoid, malaria, and other results of polluted drinking water, choked sewers, decaying refuse and mosquito-breeding pools left behind by the receding waters.

As the flood spread into the back areas ten, twenty, thirty miles, it flattened out into a quiet, lazy, muddy sea. In this vast area towns were submerged and millions of acres of land covered with the pale yellow liquid. Partly submerged forests made difficult the bringing up of supplies in small motor boats to those on the levees and taking to safety those who had remained in their homes with the vain hope that the water would not reach them.

*Assistant sanitary engineer, North Carolina State Board of Health.

Where this was the condition the stillness of this great inland sea was broken only by the occasional staccato exhaust of a motor boat or the almost inaudible dip of a paddle as a negro slowly pushed along his crude little canoe filled with hay for stock living on a raft or on the levee. The submerged highways were the boat lanes between large cleared areas. On each side of these lanes was impenetrable timber growth and floating logs. In the wide cleared spaces an occasional wisp of smoke arose from some half-submerged house whose occupants had moved into the upper story and were patiently awaiting the outgoing of the muddy tide. At night the long gleam of light on the water from a second story window pierced the darkness like a lighthouse to the late traveler in the small boat.

This great area had been only a few weeks before the scene of activity. Trains shuttled strings of cars carrying the homeless to high ground. Every type of small boat and barge was pressed into service and manned by volunteers for the rescue work. Airplane observers searched the isolated places and reported to the boats the people on house tops and in trees. Rescue par-

ARKANSAS CITY, ARKANSAS, DURING THE FLOOD
Levee camp and river steam boats on the right. Elevat ed tank and pumping station at extreme left background. Floating houses and debris in foreground

VIEW FROM REAR OF TRAIN MOVING THROUGH THREE FEET OF WATER AT ABOUT THREE MILES AN HOUR
Railroad bridge on right of water tank, highway bridge on left

ties worked day and night without sleep in the race with the rapidly rising water. The race was toward the high ground and to the levees. Camps were established to receive the refugees. On the levees an almost continuous line of tents sprang up to shelter the homeless. The levees formed a narrow island haven in the muddy sea. The breaks in the levees caused sections miles in length to be isolated. Food and medical supplies were taken to those marooned at risk of life by those in motor boats entering the swift currents.

Little time was available to provide camps for the incoming thousands. Railway freight cars made convenient shelters for family groups and could be quickly placed in concentration points. Families brought along in the cars their pigs, chickens, dogs and household furniture. A typical camp scene was lines of freight cars each with its projecting kitchen stove pipe, a rough ladder for door steps, grunting pigs in crude pens, chickens in boxes and a dog tied under it. The members of the family thus occupied the same car in which they were brought out of the water until they could be carried back to their farms by the railways. Tent camps were established for those who came in by boat or wagon.

The refugee camps ranged in size from a few tents on a plantation to the larger railway car camps which contained as many as five thousand people where rail sidings permitted. The concentration of many families of refugees in tent and car camps produced problems in both individual and group health protection. For assistance in providing protection against disease the nation generously supplied doctors, nurses, sanitarians and medical supplies, as well as money to carry on the work.

Methods for refugee camp sanitation had to be worked out hurriedly. The negro population of the camps was greater than seventy-five per cent. of the total. The negro families were not accustomed to living in groups and were awed by their new surroundings. The type of negro living on the inundated plantations possesses very low intelligence. The natural complacency with which a negro accepts his fate and his absolute dependence upon others for food and clothing kept camp disturbances at a minimum. Negro laborers were plentiful among the refugees. The men were organized into companies or gangs and placed under a reliable person. This company leader was made responsible to the camp commander for the sanitary policing of a definite section of each camp. This placing of responsibility for a task, and recognition by the camp commander of those who performed their assignments well, kept up a good morale and broke the monotony of camp idleness. National Guard detachments provided police protection in the camps and enforced sanitary regulations among the inevitable few who go counter to emergency rules and orders.

The providing of safe drinking water for temporary camps presented a problem in sanitary engineering. The camps were located over a wide area with means of transportation extremely slow and difficult. Emergency supplies were difficult to obtain. With a few exceptions where a supply could be piped from city systems, all water for camp use had to be obtained from temporary sources. The character of the soil made possible the driving of small pump piping. Equipped with hand-operated pumps, these wells were located along the tracks which held the refugee cars. Time did not permit the selection of source of supply to be guided by laboratory analysis of product. Obviously dangerous wells already in use were immediately closed. Water from locations under suspicion was chlorinated with chloride of lime in barrels for the entire camp or boiled on individual family stoves.

Many thousands of the refugees marooned on the levees were forced to drink the flood water. The water in the rivers and behind the levees carried much mud and finely suspended material. If it had been possible to distribute chloride of lime to all the levee refugees and instruct them in its use, the effectiveness would have been extremely doubtful. Levee refugees could not come to a nearby central point for sterilized water, and boiling individual supplies was almost entirely relied upon for protection. Every agency working along the levees helped spread the warning of the danger and the necessity for boiling all drinking water.

The temporary nature of the refugee camps and the lack of funds made sewerage systems out of the question. Latrines were constructed to receive human excreta. The high ground water level, which stood often within a few inches of the surface, necessitated frequent mov-

ON A MISSISSIPI RIVER LEVEE AT MODOC, ARK.
Negro Refugees Getting Typhoid "Shots" at Red Cross Field Hospital

ing of seat boxes and filling of pits. Abundant labor was available for this work. It was found that sand bags could be piled around the pits to form a water tight base for the seat box. This method extended the usable life of the pit by increasing the space above the level of the ground water. Hogs required all kitchen refuse and disposal of this type of camp waste was thus simplified.

As the water of the great inland sea receded and the inhabitants of recently submerged towns returned, it became necessary to quickly put the towns in a sanitary condition and to provide safe water supplies. Many people had stayed through the period of submergence by occupying upper floors of buildings and using the porch roof as a boat landing when entering or leaving. In many places swift currents added to the toll of the rising water. Houses were twisted on their foundations or carried blocks away to lodge against trees. Floating debris settled everywhere. The falling water left its stain on all interior and exterior sidewalls. Garage oil tanks

FLOOD RECEDING AT WATSON, ARK.
Note high water mark on freight cars and houses

contributed a film of oil on the surface which left its dingy greasy coating on buildings. Streets were piled with rubbish and the flotsam of the flood. All agencies set to work at once to rehabilitate the towns. While property owners were cleaning their own premises, labor gangs cleaned mud and collected debris from the streets. Crude oil was used freely to burn wastes collected from the streets. Animal carcasses were disposed of in similar manner.

Putting the public water supplies in a safe condition was perhaps the most vital necessity to the repopulated towns. Public water supply wells were in practically all instances topped by the flood water. Electric motors and service pumps were covered by water. Oil and steam power units suffered likewise. After motors had been dried, the wells were pumped to discharge flood water. Floating houses broke many service pipes, allowing surface water to enter distribution systems through the exposed ends. Distribution systems were flushed to eliminate mud. Chloride of lime in sufficient quantities to give free chlorine at ends of mains was mixed into elevated tanks and reservoirs. Wells and pumps were of many types and ranged in condition from properly protected modern installations to practically obsolete set ups. Where the type of well pump permitted, emergency chlorinators were installed and mains and water sterilized with a high dosage of chlorine. In some areas boiling all drinking water was the only safe method regardless of all efforts to flush and sterilize systems. In rural sections, boiling all water from wells was necessary. Posters explaining the danger of drinking flood contaminated water and warning to boil all supplies were freely distributed and displayed.

The immense task of rehabilitation of the devastated area is now under way. In this program must be included organized efforts to better the agencies promoting the public health. In the rural sections houses must replace the temporary tent-homes given by relief organizations to returning refugees. Much of the farm live stock must be replaced. Many small cities and towns must be largely rebuilt. Roads and bridges are to be repaired and replaced. Water supplies from ground sources must be improved and protected from possible high water. Unceasing effort to control malaria is a vital part of the program, otherwise the progress of rebuilding will be severely retarded by the toll of malaria.

Perhaps the greatest asset in the rehabilitation of the devastated region is the dauntless spirit of the people. The first impulse of a stricken populace is to be depressed and hopeless. The retreating water brings back hope to the heart of the flood sufferer. With property damage beyond estimation, and the effects of devastation stripping existence of all but the barest necessities, the valley dweller returns to his land. He does not want to be an object of national charity. He wants only a fair and even chance with the river. The unending fight with the Mississippi river must go on. The man-made defenses are torn and penetrated by the river. Only an adequate national program of flood control can prevent a recurrance of the 1927 disaster.

Cost Keeping on Street Department Work

Savings effected in Rockford, Ill., by use of uniform cost records of street cleaning, and other advantages of such records

"If we do not know the facts as they are, how in the name of common sense are we going to better them?" said Robert B. Brooks, director of the Department of Streets and Sewers of St. Louis, at the convention of the International Association of Street Sanitation Officials, when urging the adoption of common-sense cost keeping methods on street cleaning and other municipal work.

This was said in discussing a paper by B. C. Harvey, city engineer of Rockford, Ill., entitled "Methods and Advantages of Uniform Cost Keeping," in which paper Mr. Harvey said: "Should not a municipality know how much it costs to execute its different kinds of work? Should it not be in a position to know whether or not the same work could be done at a saving by awarding the work to contractors?

"Keeping accurate cost records will help a municipality in purchasing the best kind and type of

equipment for each respective work. It will also determine for a municipality whether work can be done more economically by hand-operated equipment or by mechanically operated equipment.

"Here is one illustration: In 1925, Rockford cleaned 43,647,127 square yards of pavement at a cost of $16,674.07, or at a cost of $5.77 per hour or 38.2 cts. per thousand square yards, including depreciation, overhauling, truck service and labor. Assuming common labor at 55c per hour, this would mean that 10½ men could be employed for the same rate of pay per hour as one sweeper and operator, also labor and truck service. During this one hour the same 10½ men must sweep 15,104 square yards, or each man must sweep 1440 square yards. Now assume that one man is to push a broom 14 inches wide; in order to cover an area of 1440 square yards, a man must push the broom a distance of 11,108 feet, or approximately 2.1 miles per hour, and at the same time the same man must pick up his sweepings and haul them to a city dump. It can readily be seen that this is a physical impossibility. Yet how should we know this if we did not keep cost records?

"By keeping cost records it can readily be determined which type of equipment or which type and kind of truck is most suitable for the work which it is called upon to do. Will a two-ton truck on pneumatic tires give you more service and cost less per cubic yard of material moved than a 3½-ton truck on solid tires? The answer is given by keeping accurate cost records."

As an illustration, the author referred to the cleaning of catch basins by an auto-eductor. A card filled in by the operator shows the hours operated, the location of catch-basins, yards of dirt removed, loads hauled, location of dump, and number of catch-basins cleaned. This information is placed on a cost sheet in the office which shows the cost of gasoline and oil, repairs of eductor, together with overhauling, salary of operator and laborer, and depreciation. This total cost is divided by the number of catch-basins cleaned, giving the cost per catch-basin; and is also divided by the number of yards of dirt removed, giving the cost per cubic yard of dirt removed. A depreciation of $8.00 per day, including interest, is charged against the eductor each day the machine operates. The depreciation is determined as follows: The life of the eductor is assumed as six years, or about 1300 working days, and the cost of the eductor, $8,825, is divided by 1300 working days, giving $6.78 per day. Adding to this the interest on the depreciated cost for the several years gives a total of $1544, which, divided by 1300 days gives $1.18, making the depreciation and interest approximately $8.00 a day.

The same subject was discussed in a paper by Carl Schneider, aide to the commissioner of public property of New Orleans, in which he said: "There can be no question as to whether such cost keeping possesses advantages. It not only permits a comparison of similar work in various cities but, what is more important, it enables each municipality to compare its own performance from time to time. It also permits the comparison of various methods of performing the same work, such as horse vs. motor flushing; trailer collection of refuse vs. carts or wagons."

Modern Pumping Station for Bessemer

By K. W. Grimley*

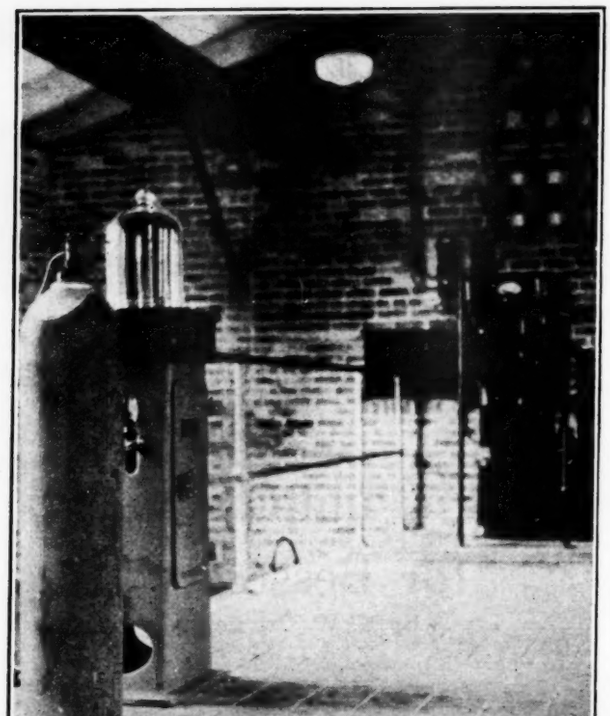
In line with the modern policy of public utilities in devoting considerable attention to the appearance of their properties, the Alabama Water Company has recently completely rebuilt the pumping station for their system at Bessemer, Alabama. The structure is typical of what can be accomplished by a public-spirited utility toward harmonizing such plants with high class residential districts.

For over twenty-five years the city of Bessemer (with a present population of 25,000) has obtained its water from Hawkins spring, a large limestone spring located in what was originally farming country between Bessemer and Birmingham. With the phenomenal development of the Birmingham district during the past ten years, the farms have given way to residential suburbs, and the old wooden pump house has been somewhat out of keeping with its surroundings.

Architecturally, the new building is of the Spanish type, which has found such favor with modern homebuilders in the South and West. Its appearance shows careful design, and blends well with its setting in a small grove. The arched colonnade with its three windows, the large oak door, and the curved wing wall and gate, as well as the general outlines of the building, are typical features of the new order. Careful attention has been given all details; for example, all hardware is of massive hand-forged iron. Flanking the building on the south is a high wall, gracefully decorated with pillar top flower boxes. This serves to hide the spring sump cover, which is usually such a hideous addition to most pumping stations. The entire structure is of stucco on brick, with a red tile roof supported on the usual wooden rafters and sheeting.

BESSEMER PUMPING STATION AND WALL

*Assistant sanitary engineer, Board of Health, Birmingham, Ala.



INTERIOR VIEW OF BESSEMER PUMPING STATION

The interior has been designed with as much attention to engineering efficiency as the exterior has to architectural beauty. On the operating floor, composing the front half of the building, are located the switchboard and other electrical fixtures, meters, and a Wallace & Tiernan chlorinator of the latest type. The other half of the building is devoted to the pit, wherein are located a Worthington centrifugal pump directly coupled to a G. E. motor. Space has been provided for another pumping unit for future use. A 14-inch I-beam supports a traveling hoist over the mechanical equipment.

Use of Trenching Machinery by Waterworks Departments

Trenching machinery is used by the water departments of 102 of the cities reporting in the June number of PUBLIC WORKS. Of the 784 cities answering the questionnaire, about 650 are represented in this tabulation, thus indicating that not more than 15 per cent of the waterworks departments use mechanical equipment for trenching. The remainder rely largely on the pick and shovel.

Trenching machines, steam and gas shovels, excavators, ditchers, drag lines, plows, trench hoes, and scrapers, are among the equipment reported as being used.

The following equipment was named by one or more of the cities: Drag line excavators, Inslev excavators, Bay City trenchers, Buckeye traction ditcher, Barber-Greene trenchers, Byers "Bear Cat" trenchers, Keystone shovels and excavators, Parsons trenchers, Austin trenchers and Fundom pull boom trenchers.

Back-filling appliances were reported by 88 cities, including road machines, steam and gas shovels, scrapers, graders, tractors, backfillers, etc. Among the equipment listed were Buckeye trenchers, drag lines, Bucyrus shovels, Parsons backfiller, Waterloo backfiller, Fordson and other tractors with and without Baker attachment, Byers "Bear Cat" graders, Keystone graders, and Austins.

Trench tamping methods were reported on by a large number of cities, most of which let nature do the tamping. Puddle was reported specifically by 18 cities; 2 cities used rollers, 1 used a tractor, and 27 reported the use of compressed air tamping equipment.

Only 25 cities reported the use of compressed air for calking joints. Four hundred reported the use of instruments for locating pipes, and 33 of instruments for locating leaks.

Lead and leadite are by far the most popular jointing materials, these being used by 674 cities, many of them using both materials. Lead Hydrotite was reported by 23 cities, and cement by 10.

Special pipe cutting equipment was reported by 77 cities, most of the others apparently employing hand methods. Among the pipe cutting equipment mentioned were Barnes, Ellis, Barnes-Ellis, Ellis-Ford, Reed, Tucker and Ellis, Mueller, Oster, Toledo, Anderson, Strickler, A. P. Smith, and unnamed acetylene cutters.

American Water Works Association

Continuation from the July issue of the narrative of the annual convention, with abstracts of papers and discussions

Two sessions were held Thursday morning, June 9, one being devoted to well water recessions, and the other to purification. M. M. Leighton discussed the "Geological Features of Northern Illinois in Relation to Underground Water Sources." He was followed by James H. Lees of Iowa, Leon Smith of Wisconsin, and Charles Brossman of Indiana. The lowering of the ground water level in these States has been steady but slight in Indiana, while in Wisconsin there has been a recession of about a foot a year for nearly thirty years. Ground water levels have fallen, which was attributed to farm drainage and drainage district work.

Mr. Scott Johnson, chief engineer of the Missouri State Board of Health, spoke on sanitary safeguards for wells. He recommended casings of adequate weight and proper construction to eliminate danger of surface or near-surface contamination. Proper seating and sealing of the casing is most important. To assure proper construction, uniform specifications are required to be incorporated in all contracts, whereby, through the cooperation

of the state geologist, a complete record of the well is secured. From these data, the depth of casing necessary to exclude contamination is determined. The setting and sealing of the casing is completed in the presence of a representative of the state geologist; a final inspection of the complete job is made, after the pumps have been installed, by an engineer from the State Board of Health, who checks the construction, well-pit drainage, casing and effectiveness of seal.

Tests for the capacity of wells were discussed by W. G. Kirchoffer, who stated that capacity was determined by the fineness of the sand rather than by the effective size. A sand with a fineness modulus of around 300 would indicate a good yield.

At the water purification division meeting, after a paper by Robert Spurr Weston on the decolorization of soft waters, which was discussed by Wellington Donaldson, W. F. Langelier, and H. E. Miller, who described the unusual conditions at the Southern Pines (N. C.) plant, C. H. Christman spoke on the use of sodium aluminate as an aid to alum in coagulation. He stated that the use of sodium aluminate in small quantities reduces materially the amount of alum required, the saving averaging probably 25 per cent; about ¼ grain per gallon is the maximum usually required. There was discussion by A. R. Spalding, who told of the experiences of the Hackensack Water Co. with sodium aluminate, and by F. W. Green, Wellington Donaldson, and F. O. Baldwin.

Clarence Bahlman, chief bacteriologist of the Cincinnati filtration plant, summarized the results of his studies on double coagulation. The treatment methods in use at Cincinnati consist of 72 hours sedimentation, coagulation with iron and lime, followed by 5 to 8 hours sedimentation, and filtration. In the double coagulation studies, alum was applied in the force main 2,100 feet from the primary settling reservoirs. As a result of double coagulation the turbidity and B. Coli load is considerably decreased and longer filter runs and better colon results are possible. The filter runs were increased 30 to 60 per cent. A composite of 6 runs, where B. Coli totalled 1,100 or more per 100 c.c. in the raw water, showed an increased cost of 86 cents per million gallons for double coagulation, an increase in filter service of 31.1 per cent, and a reduction in the average B. Coli content of the filter effluent of 8.30 to 1.54 per 100 c.c. As a result of these studies, it appears advantageous to use double coagulation for about 40 per cent of the time at Cincinnati.

The paper by C. P. Hoover on "New Developments in Water Softening," which was scheduled for Thursday morning, and another by John D. Fleming on "Pre-sedimentation and Basin Detention at St. Louis" were postponed and presented at a later session. Mr. Hoover reviewed late improvements in the handling of chemicals, in chemical mixing devices, and in the removal of settled solids. He cited experiences in Columbus, where, he stated, the use of zeolite treatment would be much cheaper than the present method, using soda ash.

The paper by Emil Nuebling regarding experiences with wrought iron, lead, and copper service connections and goosenecks appeared in the July issue of PUBLIC WORKS. E. E. Minor, speaking on recent control developments in electrolysis, stated that ground connections on services should be made so that removal of the meter will not interrupt the electric circuit, or a connecton around the meter should be provided. A paper by Prof. M. L. Enger on "Tests of Friction in Cement-Lined and Tar-Coated Pipes" was added to this session. He stated that the results of the tests showed that in sizes over 4-inch, the cement lined pipe was superior. The tests were made on 4, 6, and 8-inch pipe.

The use of aeration as a method of water treatment in Texas was discussed by W. S. Mahlie. Thirty replies had been received to a questionnaire regarding Texas water supplies, 14 of which were surface supplies, 15 well supplies, and one both well and surface. Three of the well supplies and all but one of the surface supplies, reported taste and odor troubles. Of the latter, 8 use aeration; and 2 of the well supplies reporting odors and tastes use aeration. In all instances, improvement was reported following aeration.

A. W. Bull and G. M. Darby of the Dorr Co. reported experiments carried on for some time regarding sedimentation of turbid river waters. These included studies of sludge thickening, deposition, and discharge, and clarification tests under various depths and conditions. Pre-sedimentation was discussed at length, and it was stated that it was advantageous in the case of highly turbid waters, resulting in a saving in chemicals, improved plant operation and reduced operating cost. Observations as a result of 7 years of operation of the Toronto "drifting sand" system of filtration were related by A. V. Sanderson, superintendent of the plant. He stated there was a saving of time by the use of this method because of the elimination of time losses for cleaning the sand, while operating results were very satisfactory.

Ralph Silver, in an illustrated lecture, told of recent developments in cast iron water pipes. H. W. Streeter, chairman of the Committee on Practicable Loadings for Purification Plants, read the committee report. The results on sedimentation, coagulation, and filtration were given, but Mr. Streeter stated the results to be only tentative and subject to revision by later findings. Further experiments will be conducted over a wide field by a number of plants operating under different conditions.

Street Name Signs in England

The ideas of the Institution of Municipal and County Engineers relative to street name signs were set forth in the report of the council of the society at the annual meeting on June 15 at Torquay, England. They were stated as follows:

(1) That it is desirable that street names should be made as prominent as possible.

(2) They should be visible to both traffic streams.

(3) They should be placed on both sides of the street.

(4) Street lamps should wherever possible be used for the exhibition of signs so that they may be illuminated at night.

(5) The letters should be at least 6 in. in height, in black on a white background, unless the Minis-

try are satisfied after research that other colours would be so substantially better as to justify alteration.

(6) The signs should not be more than 10 ft. from the ground level wherever possible.

(7) The signs should be surrounded by a blank space and should not be placed among advertising signs.

(8) The signs should not be more than 15 ft. from the street line or from the junction of two streets.

(9) The signs should be placed at every street junction and should be repeated where necessary.

(10) Important junctions and cross roads should have special illuminated signs.

(11) In the case of streets with common names the name of the district should be added.

(12) Road classification and route indications, if given on or placed near street signs, should be of a different type in order to avoid confusion.

(13) In many cases signs will have to be erected independently of the buildings to meet modern requirements.

Charleston Water Works Notes

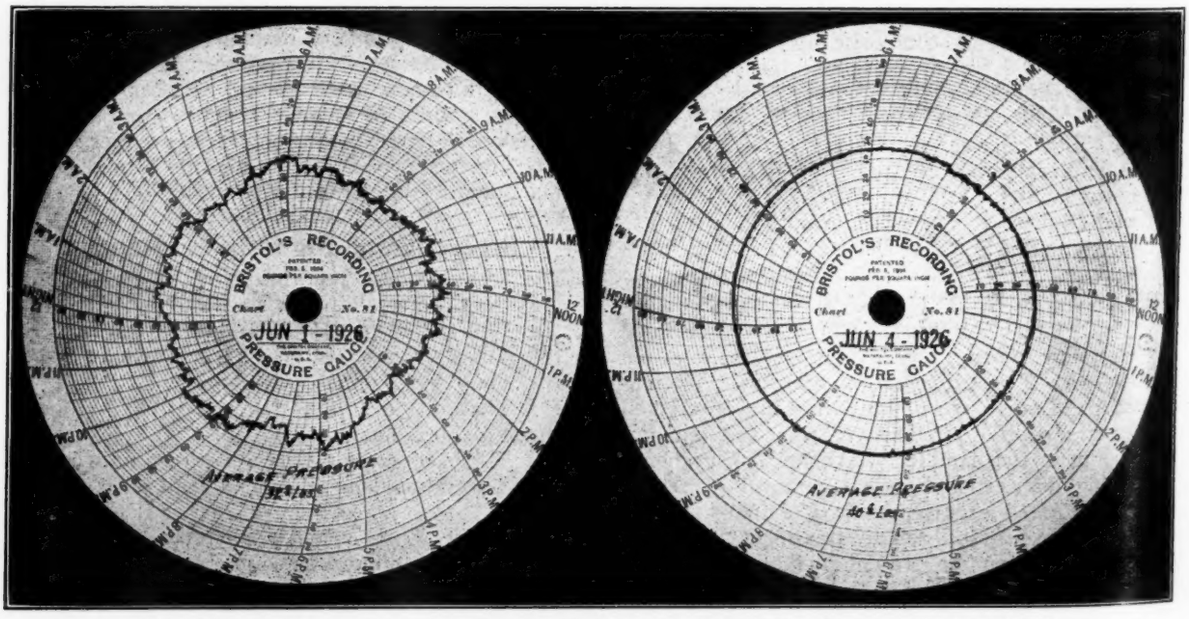
Two-million-gallon tank permits uniform pumping rate and gives uniform service pressure. Purification notes. Water wasted by public institutions

The annual report for the year 1926 of the Water Department of Charleston, South Carolina, by J. E. Gibson, manager and engineer, describes a number of features which will interest water works superintendents and managers of other cities. Among these is the new elevated tank put into service in June of last year. This is described by Mr. Gibson as being the department's most notable improvement of the year. Contract for this tank had been awarded in 1925 to the Chicago Bridge and Iron Works and was completed the latter part of May, 1926 and the tank put in service early in June. The tank had a capacity of 2,000,000 gallons, an ellipsoidal bottom, was 80 feet diameter by 35 feet high and elevated from the ground 85 feet to the bottom of the vertical side plates. With this tank in service, the department is able to run the pump at a uniform rate and load throughout the 24 hours, permitting higher efficiency in operation and a reduction in the maximum pumping head due to the average rate of pumping. It also reduces the accident hazard because of the lower pressure required.

The weight of the tank when full, including foundation, is 22,120,000 pounds; the weight of the steel work being 1,350,000 pounds and of the water 17,170,000 pounds. The minimum thickness of plate in tank shell is ⅜ inch. The columns are Bethlehem H sections. The steel structure complete cost $67,000, the land $3,060, and bitumastic enamel for the inside of the tank and paint for the outside, together with engineering, incidentals, and the pipe line to and from the tank to the existing piping system totaled $5,758. The total cost, including fencing, foundations and all items was $99,009.

Careful examination and study was made of the foundation and the safe bearing value of the soil. This consisted of 12 inches of top soil, 18 feet of dry yellow sand, 9 feet of tough dry clay, 4 feet of light yellow sand, 14 feet of dark gray sand and water, and 10 feet of clay mud and shells, below which was marl. Many tests for bearing value were made by means of a weighted platform mounted on a square post having an area of approximately ½ square foot. Tests were made at three locations and the settlement varied from ¼ inch with a load of 4,000 pounds per square foot, to 2.6 inches, after a 16,000 pound load had remained for twelve days.

The foundations were calculated for a load of 2¼



PRESSURE CHARTS SHOWING IMPROVEMENT IN PRESSURE DUE TO USE OF TANK
Average pressure increased from 32.2 lbs. to 40.6 lbs. Maximum 60-minute variation reduced from 16 lbs. to 2 lbs.

tons per square foot, including live and dead loads and foundations. When the tank had been completed and was filled to test for water tightness, observations and levels were taken on each column pier to note the settlement and the maximum settlement of any one pier was found to be 1.656 inches and the minimum settlement 1.333 inches. The tank was then emptied for painting, when the foundations rose an average of ⅜ inch, and on filling the second time the tank again settled to the previous position.

PURIFICATION

The water is treated by sterilization with liquid chlorine, coagulation with sulphate of alumina, sedimentation and filtration through gravity mechanical filters, and restoration of alkalinity by the use of sodium hydroxide.

Considerable trouble has been found with algae and the taste contributed by the same, and copper sulphate is used in the impounding reservoirs, with small amounts at the outlet from the sedimentation basin to the filters, and a much more restricted amount in the clear water basin to prevent the development of algae in this basin. The growth of anabaena in the raw water reservoir was exceptionally pronounced during the months of July, August and September. To overcome this trouble, it was decided to install an aeration system in the sedimentation basin.

Caustic soda or sodium hydroxide is used to restore the alkalinity in the filtered water rather than lime or soda ash, as by this the water is artificially softened rather than hardened as with lime treatment, and the carbonic acid content in the filtered water can be much more easily controlled.

Colorimetric tubes are used in the laboratory for determining the hydrogen-ion concentration. The average pH value of the hydrogen-ion concentration of the filtered water obtained from the mains in the city is 7.0, the raw water averaged for the year 6.7, the filtered water entering the filters averaged 5.5, and the filtered water in the clear water basins averaged 7.7.

MUNICIPAL USES OF WATER

During the year the department furnished water to city institutions and for street cleaning and flushing the sewers, of an estimated value of $18,474. About 60% of this amount was for the city sewers, flush tanks and street cleaning, and was estimated. The other amount was metered, and was used in hospitals, city stables and incinerators, engine houses, city hall, orphan homes, public markets, police stations, horse troughs, etc. The estimated amount of water so used was 16,560,000 cu. ft., which is about 260,000 cu. ft. more than the previous year, 220,000 cubic feet of which amount was an increase in consumption by the Orphan House, which increase Mr. Gibson was unable to account for as the number of inmates had been materially reduced and, based upon the average consumption of a city household, the water consumed would have been sufficient for a community of 900 persons, many more than occupy the house. Commenting on the report, the chairman of the Commissioners of Public Works, Julius H. Jahnz, said: "I am of the opinion that greater economy could be obtained if the various city institutions would be required to pay their own water bills out of appropriations allotted to them." The free water furnished amounts to a little over 6% of the total amount pumped to the main as measured by the station meter.

Shepaug Tunnel, Waterbury Waterworks

Construction of tunnel more than seven miles long, containing two forty-five degree bends, without sinking shafts. Stopping seepage of ground water. Lining with concrete

By George E. Clapp

The city of Waterbury, Conn., is completing a tunnel known as the Shepaug tunnel, the designing and constructing of which has involved several interesting and unusual features. This tunnel is an important part of a project for increasing the water supply of the city at a cost which will probably reach five or six million dollars when all of the developments have been completed.

The project includes a dam on the Shepaug river, about fourteen miles from the Naugatuck Valley in which the city lies; a tunnel about 7½ miles long, divided into two sections by an open construction about 1300 feet long; a pressure conduit at this point carried beneath the bed of the river through three lines of cast-iron pipe; the construction of a reservoir at the end of the tunnel, and a cast-iron pipe line from this reservoir to the city involving about 10 miles of excavation work and a 1½ miles of tunnel.

The city some years ago had water rights on the Bantam river valley but lost them through legislative action when the people in the vicinity of Bantam lake protested against the diversion of the water. The city then went further west to the Shepaug valley and found there a watershed of about 38 square miles, separated from the city by two lines of hills of considerable height.

Borings were made along the route between the proposed sites of the diversion dam and of the reservoir which is to receive the flow through the tunnel, and these showed that to carry the tunnel in a straight line would take it through swampy land where soft rock and low ledges are numerous. The line finally decided upon runs practically east from Shepaug river, crossing Bantam river and striking an arm of Bantam lake; here the tunnel turns about 45 degrees to the south in order to avoid low ground where the rock dips considerably below the tunnel

grade, and after nearly a mile in this course the tunnel again turns 45 degrees to the east, parallel to the original course, and thence proceeds straight to the reservoir.

The customary course would have been to sink a shaft at each angle point, thus having only straight tunnels to drive between shafts. The engineers, however, decided not to sink any shafts in the work, believing it would be more economical not to do so. Resident engineer I. F. Story, explaining this to the writer, stated that contractors anxious to finish the job as speedily as possible would naturally sink the shaft at the angles, thus giving four more headings to work on. This, however, would have necessitated leasing the sites of the shafts; the cost of sinking the two shafts 150 feet deep or more is roughly estimated at about $100,000, and removing the excavated rock through these shafts would have cost considerably more than bringing it out on grade through the tunnel as was done. The section of the tunnel east of the Bantam river is nearly 24,500 feet long, 13,129 feet of which was driven east from Bantam river, and 11,358 feet west from the eastern or Heminway portal. The two headings came together with less than an inch variation of center lines.

Another unusual feature of this work is that the city did all of the work with its own employees with the exception of 570 feet of open cut between the two sections of the tunnel. During the height of the work the city employed as many as 225 men. When the work first started, however, in December, 1922, only one shift of common laborers was employed and the city added to the force and the machinery employed gradually as the nature of the rock encountered and other features of the work developed.

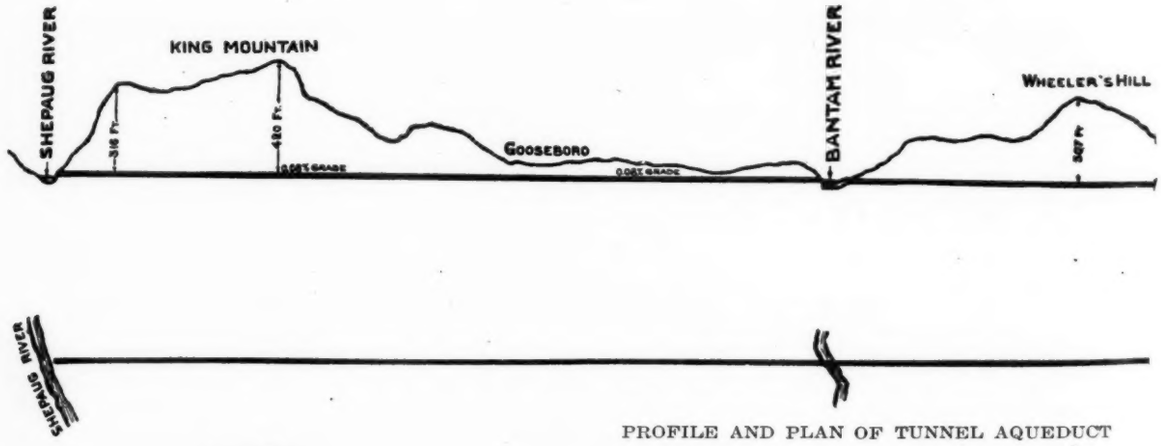
THE TUNNEL

The inlet of the tunnel is situated on the east bank of the Shepaug river about a mile and a quarter north of the village of Woodville. Here a low diversion dam will be built (construction has not yet begun). It is proposed later to raise this dam to a height of 100 feet, which will create a reservoir of large capacity. This dam, which will cost nearly $2,000,000, probably will be postponed until the increased consumption of the city requires the additional storage.

The tunnel starts at the Shepaug portal with a grade of .08 per cent, which it continues for about 13,000 feet to Bantam river crossing; from this point the grade is 0.5 per cent to the shore of Bantam lake, and 0.1 per cent from here to the eastern portal.

The tunnel, of horse-shoe section, was excavated 7 feet wide and 7 feet 6 inches high, and is 6 feet wide and 6 feet 6 inches high inside the concrete lining; the radius of the concrete invert being 11.85 feet. The entire length of the tunnel is to be concreted on the invert, while the sides and arch of the tunnel will be concreted only where this is necessary for shutting out seepage. At this writing about three miles of the invert have been concreted, but none of the arch. The average yield of the drainage area is estimated to be about 40,000,000 gallons per 24 hours, but the tunnel will carry more than twice this amount.

The entire tunnel is through solid rock except at the Bantam river crossing above noted and at the two ends. At the Shepaug end about 300 feet of tunnel is through sandy hardpan; at Ravenscroft swamp, just west of the Bantam river crossing, there is 570 feet of concrete conduit laid on piles in a 30 foot cut. The river itself is crossed with three lines of 36-inch cast-iron pipe 700 feet long between shafts. A short tunnel known as the cross-cut tunnel begins at a point 350 feet east of Shepaug portal and runs northwest to the diversion dam, this being the inlet from the dam to the main tunnel. The 350 feet of tunnel between the west portal and the



PROFILE AND PLAN OF TUNNEL AQUEDUCT

crosscut tunnel will be left open as an inspection entrance and for removing any leaves or silt which may accumulate at this end of the tunnel.

Actual excavation of the tunnel began in 1922 and the last section was holed through in the fall of 1926. The concreting of the tunnel is now going on.

Beginning at the Shepaug river, 213 feet of earth

was tunneled before reaching rock, and a definite rock face was reached at 250 feet. At first light machinery was used and four-foot blasting rounds. Only 100 feet had been made by July, 1923, when heavy rock drills were procured and by May 13th, 1924, when work at this heading was abandoned, the tunnel had been driven 6,652 feet.

When the work of tunneling had been thoroughly organized it was conducted as follows: The drilling crew consisted of a foreman, two runners, two helpers and a jackhammer man. At 9 o'clock each morning this crew began work. Two Ingersol-Rand 248 D I drifters were mounted on vertical columns and drilling begun. A vertical V cut was used throughout most of the length of the tunnel, with a total of 24 holes as a standard for hard rock. The holes comprised eight cuts, with a "buster" drilled to the center in hard rock, two top and two bottom relievers, seven rim holes and four lifters. The cut was drilled below the center of the cross section, the holes being spaced about 8 inches centers vertically and about 43 inches horizontally. Four lifters were used in order to throw as much muck as possible back from the face and reduce to a minimum the length of time required by the dog shift to clean up the face. The extra lifters also broke up the bottom to better advantage.

Drilling was started at the top, and by the time it reached the bottom of the cut the muck was usually out and the mucking crew ready to leave. At first the rounds were drilled to 6 feet depth but this was gradually increased until 12-foot shots were being fired at the end of the job. The drills were of 1⅛-inch hollow round Swedish steel. They were cut for two-foot changes, the gauge dropping at the rate of ⅛-inch for each change. The engineers were advised that 1¼-inch would be best suited to their needs but they used 1⅛-inch steel with excellent result throughout the length of the tunnel.

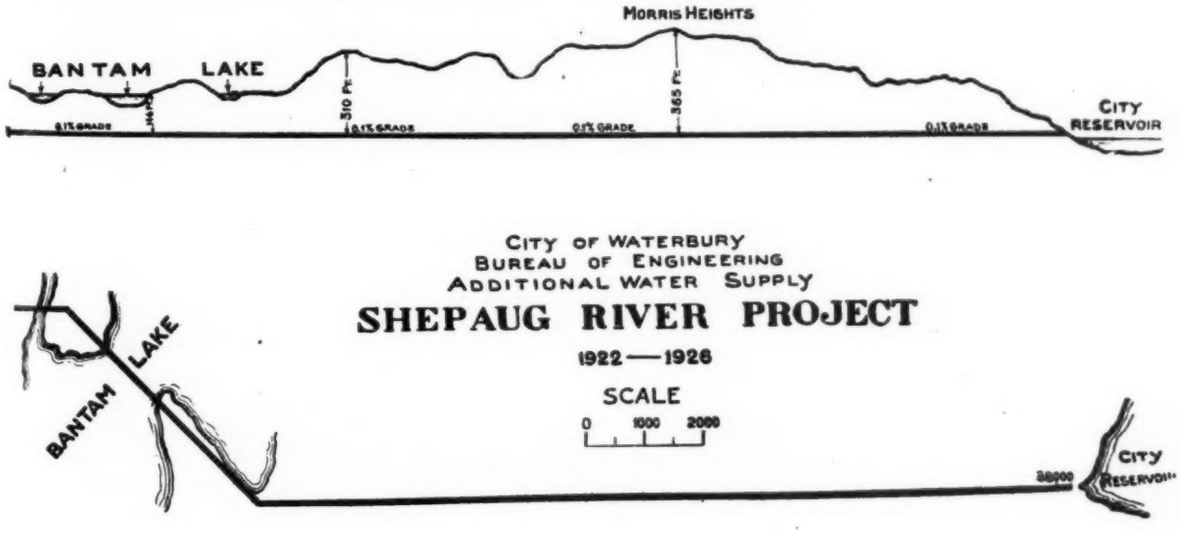
The jackhammer man was used to trim tight ground which the heading shift could not reach, for plug and block holing, and also for helping the shift with the shooting.

In blasting, 1¼-inch by 8 inch, 60% Dupont gelatin dynamite was used with No. 6 electric blasting caps and first, second and third delay caps of the same strength; a rotation of four shots being thus available. The cut was loaded and shot independently, with the instantaneous caps. The remaining holes were loaded as follows: The remainder of the cut with instantaneous caps; the relievers with first, the rims with second, and the lifters with third delays. The caps were connected in series, tested with a galvanometer and hooked to a length of ordinary No. 18 annunciator wire, which in turn was connected with the main No. 14 blasting wire, which was carried back about 100 feet from the face.

While the round was being loaded, one man took down two or three lengths of the water line nearest the heading and screwed a ⅜-inch nozzle on the end of the compressed air line, wiring this line as close to the roof as possible. On the way back from the face, the compressed air line was opened to drive the smoke back from the face as soon as the shot had been fired.

The firing box was located in a manhole, the electric current being taken from the lighting circuit. Manholes were recesses about 6 feet wide and 7 or 8 feet deep and the height of the tunnel, located every 700 feet. In these were placed the pumps as well as the firing box. No manhole was occupied as a firing station, however, until the heading was at least 600 feet distant. Two keys to the firing box were provided, one for each heading boss, who must himself unlock the door, close the circuit by means of a detachable push plug outside the box, and then close the knife blade switch to fire a shot. When the shot had been fired the switch was opened, the plug outside the box detached, and the firing box locked by the foreman. As a guard against carelessness, a trigger was built into the firing box which automatically opened the switch when the door was closed. In all of the blasting work in the tunnel not a man was injured from dynamite explosion.

Thirty to forty-five minutes after a blast had been fired, the dog shift of three men climbed over the debris to the new rock face and cleared out the rock to tunnel grade for a distance of 7 feet back from the heading, to provide room for the drillers to set up for the next cut. About two and a half



MUCKING CARS AT EAST BANTAM PORTAL

hours were required for this work. These men were paid a day's wages for two shifts.

At 7 o'clock in the morning, when the dog shift had been at work for some little time, the regular mucking crew entered the tunnel and began clearing the tracks of scattered rock and working toward the main pile. The work of cleaning up the tracks usually took about an hour, following which the loading of the large portion of the stone displaced in the blast began. Nine men composed this crew, divided into four pairs supervised by the ninth man, the foreman. Two men worked with picks loosening and overhauling the pile, two with shovels loading cars, two pushed the loaded cars to a point where they could be picked up by a locomotive, the seventh man cleaned up the sides of the tunnel and did miscellaneous work and the eighth man acted as train man. When five or six cars had been loaded a shift was made, the pickers becoming shovelers, the shovelers trammers, the trammers pickers, and the two auxiliary men continuing at their original job. Thus the heavy work was divided up equally among the members of the crew.

As soon as a car had been loaded it was pushed by hand to a point beyond the last empty car (empty cars were thrown off the track as soon as they arrived at the scene of the work) and this empty lifted back onto the track and pushed up to be loaded. A certain amount of the tramming was done by the locomotive while it was waiting for a train to be made up. Ten-train cars were hauled by the locomotive.

The average amount of muck handled by each shift was about 50 cars or 40 cubic yards, at the rate of 6 or 7 cars per hour. The maximum was much better than this, 66 cars having been loaded and a piece of track laid in eight hours. The last operation of the mucking shift was to lay tracks. Twenty-pound rails of 24-inch gauge industrial track in 15-foot sections were used. After the track had been laid the muck crew arranged the pans. Ten muck pans were used, 4 ft. by 5 ft., made of $\frac{3}{16}$-in. sheet iron, to cover the track and suction pipe close to the face. About six inches of rock was scattered over the pans to protect them from flying stones during blasts.

When all of this had been completed, the crew was through for the day, regardless of the length of time put in. The average day of the mucking crew was 9 hours. Meantime, two hours after the muckers began, or at 9 o'clock, the crew of drillers began, and the routine was repeated.

The locomotives used in hauling the muck out of the tunnel and taking concrete in were four Atlas Car & Manufacturing Co., four-ton storage battery, with a draw bar pull of 800 pounds at four miles an hour and able to handle 10 loaded cars on a 2 per cent. grade. The muck cars used were built on the job at a considerable saving in money and weight. Before the work on the tunnel had been started the car best suited to the needs which could be found was an all-steel side-discharge type of 20 cubic feet capacity weighing about 1,000 pounds and costing $105 each. As the tunnel is wide enough for only a single 24-gauge track and it had been determined that the mucking programme in the tunnel would include throwing empty cars off the track and on again, the weight of 1,000 pounds seemed prohibitive and it was decided, therefore, to experiment with a wooden car of the same dimensions. Such cars were constructed on the ground by carpenters from native oak with a 3-inch by 4-inch draw bar, sills and posts of 1-inch board, bound with steel straps, and the bottom lined with 16 gauge sheet iron. The first cars built cost $85 each but the cost was gradually increased to about $95 toward the end of the job because of improvements added. This cost included $40 for wheels and axles, which were purchased direct from a manufacturer.

There was considerable infiltration in some sections of the tunnel while in others it was negligible. As most of the headings were driven down grade, pumping of this water was necessary. As soon as a manhole (referred to above) had been opened, a portable pump was set up in it and suction laid to the heading, the water being collected in a small trench on one side of the tunnel. As the headings advanced, additions were made to the suction pipe until water was being pumped for a distance of 1,000 feet. Permanent pumping stations were located at intervals of 4,000 feet. The pumps were single-stage, centrifugal, motor driven, capable of handling 150 gallons per minute under 100 feet head. In addition, a small compressed air pump was placed in each heading as close to the heading wall as practicable, for use in emergency.

At the Bantam river a power house was erected serving both headings. This contained two air compressors of the I-R "Imperial" type XPR-3, with total piston displacement of about 1800 cubic feet per minute, operated condensing; a 50 k w, 220 volt, D.C. Westinghouse generator; a small motor driven generator for battery charging purposes; a feed water heater for the boilers and boiler feed and supply pumps, which were in duplicate.

The plant is operated by a battery of three 100 h.p. Erie boilers carrying 150 pounds of steam. Directly over the east portal was located a motor driven pressure blower with a capacity of 10 cubic feet per revolution, used to remove foul air and smoke from the headings of the tunnel, the fresh air being car-

ried to within 225 feet of the tunnel face through 12-inch spiral riveted pipes hung from the roof of the tunnel.

A dry house was provided at this point, which was a large room fitted with padlocked lockers and equipped with plenty of hot and cold water. Men leaving the tunnel during the winter months, after working for hours under trying conditions, were often wet to the skin and were taken immediately to the dry house, which was kept at a very high temperature through the use of steam coils. Here the men dressed in dry clothes and thoroughly warmed themselves before leaving for the bunk houses. Because of these precautions, few cases of pneumonia were contracted on the job.

When work at the Shepaug portal had been stopped, the plant was moved to the Naugatuck valley end of the tunnel, where the portal known as the Heminway was started in September, 1924. During the winter of 1923-1924, the land at the Bantam river portals had been cleared and the power plant, sheds, etc., had been erected and the east portal at Bantam started in March, 1924, and the west portal two weeks later. Thus, by the winter of 1924 headings were progressing from these three portals at once; although difficulties at Ravenscroft swamp caused interruption of work in the west portal for several months.

The Shepaug heading had been run down grade and infiltration had nearly filled it with water by April, 1926, when the west Bantam heading approached it. When this heading had reached a point 7 feet from the Shepaug heading, determined by a test hole drilled at the top of the tunnel, a short round was prepared and a wedge shaped center of rock removed, leaving about 3 feet of rock between the two tunnel headings. A small opening was then blasted through the remaining wall and the water allowed to drain from the Shepaug heading into the Bantam heading. After about 24 hours the water had drained out of the tunnel and the foul air been removed. A check of the surveys showed that the two tunnels had met within a quarter of an inch.

The tunnel under the bed of Bantam lake passed through solid rock. About half a mile from the portal an underground stream of large proportion was reached, necessitating the installation and use of a large pump for removing it.

The two angles in this tunnel were made on a 60 degree curve. Because of the unusual difficulties in driving an offsetted tunnel more than 2½ miles long, to meet a tunnel driven toward it, without intervening shafts, these angles had to be laid out both on the surface and underground with the utmost care. This tunnel and the one from the Heminway portal met and the tunnels were holed through on September 23rd, 1926, city engineer Robert H. Cairns firing the final blast.

The maximum progress made in one day of two shifts at one heading was 23.6 feet. The maximum in two headings with four shifts was 45.9 feet. The best week's work in one heading with 6 shifts was 65.6 feet. The best month on the job with two headings was 1,100.1 feet. When three headings were underway the best month's record was 1,508.6 feet.

The engineers will give no estimate of the cost of the tunnels, since salvage on the machinery purchased for the job and no longer needed or transferred to other city construction will enter into this; but state that the appropriation for the entire job was $3,000,000 and that it is being completed well within that figure.

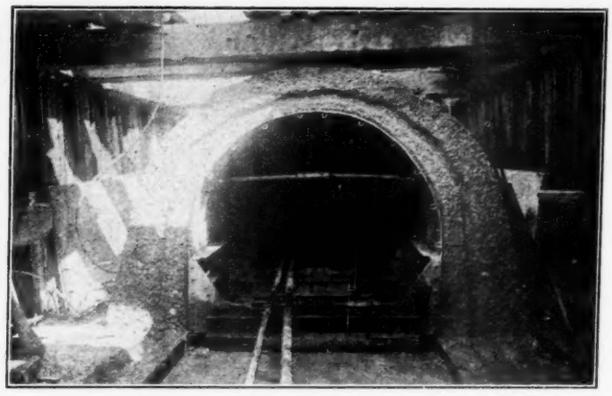
CONCRETE LINING

With the completion of the actual tunneling last fall, the city began the concrete lining of the tunnel and excluding of seepage. Because of the small size of the tunnel it was impossible to operate concrete machinery in it and the concrete is mixed outside of the tunnel and hauled in cars to the point where it is to be used. Two mixers are used in the Bantam Valley and concrete is hauled into each section of the tunnel in trains of five or six cars. Trains are already hauling concrete 2½ miles into the tunnel, and "Celite" is used in the concrete to keep it in good condition for its long haul. The cars used for invert work are all-steel, end-dumping. When the work of lining the sides and arch is started a number of side-dumping cars will be used. No work has yet been done in concreting the side walls or the arch, but a plan for it has been worked out.

LOOKING EASTWARD ACROSS BANTAM RIVER
Showing blower house over east portal, and other construction buildings

STOPPING SEEPAGE

Meantime, some of the seepage is being stopped. Slight leaks are made tight as the invert is laid. Holes are drilled into any seam which is discharging water and small pipes inserted, threaded on the outside end to take the nozzle of the grouting machine. The seam having been previously calked, grout is forced through the pipes, starting with the lowest one in the seam, a valve in each pipe in succes-



CONSTRUCTING CONCRETE CONDUIT IN SWAMP

sion being closed as that section of the fissure is filled with grout. A compressed-air grouting machine mounted on a flat car is used.

Where there is considerable infiltration through the roof and walls another method will be used. Holes will be drilled in the rock and wooden pegs driven in and wooden strips nailed to these pegs close to the rock. To these strips will be nailed sheet iron pans, for which the engineers propose to use the 20 and 24-gauge spiral riveted pipe used for tunnel ventilation, flattened out and cut to convenient lengths. Starting from the top of the tunnel, these pans, probably about 4 by 10 feet, will be applied like shingles on the inside of a roof, the bottom edge of the lowest sheet being bent into a trough which is given a slight slope toward a nozzle soldered to the lower end of the trough. Inch-and-a-half pipe will be fitted onto this nozzle and carried to the bottom of the tunnel, where it will emerge through the concrete forms that will be erected later inside the panning. There will be no accurate pipe fitting, for it is planned to make the pipe bends with large rubber hose wired onto the pipes. The water will trickle down the pans into the troughs and be carried through the nozzles and the pipes to be finally spilled onto the tunnel invert. The joints of the panning will be sealed with plaster of paris and grout.

Panning having been completed over a section, the concrete forms will then be placed. These will be of steel, in 80-foot lengths, fitted with 6-inch pipe in 5-foot sections for introducing the concrete between the form and the outside of the tunnel. A concrete placing machine operated by compressed air, stationed about 30 feet from the end of the form and fed from concrete trains, will force concrete between the forms and the panning. When this concrete has set, the grouting machine will be connected with the ends of the drain pipes leading the water from behind the pans, and grout will be forced under pressure into the whole space between the pans and the rock walls. Where the rock is solid and there is no seepage, concrete lining of sides and arch will be omitted.

OTHER WORK

The section across Ravenscroft swamp, which was done by contract, was constructed in open trench about 30 feet deep. In the bottom of this oak piles were driven to refusal, which was in most cases ledge rock. These were placed in pairs at intervals of three lineal feet under each side wall. The invert and 8 inches of the height of the side walls were then poured at one time in sections 15 feet long; the remainder of the side walls and the arch being concreted in 30-foot sections. The thickness at the crown is 12 inches, at the springing line 20 inches, and at the base of the side walls 29½ inches. The invert is curved to a radius of 10.81 feet and has a minimum thickness of 12 inches. An 8-inch tile drain was laid with open joints under the entire length of conduit, the pipe trench being back-filled with gravel. Over a year was required for completing this piece of work. The material excavated was peat bog which was so semi-liquid that it passed around, under and even through the joints of the 14-inch Lackawanna steel sheet piling. As it contained considerable quantities of fine roots, it could not well be pumped, it was too thin to be shovelled, and had to be bailed out.

The Bantam river crossing with cast-iron pipe has not yet been started. The pipe lines will probably be laid in a sand-bag cofferdam. Just outside the two portals on opposite sides of the river will be sunk large shafts, the bottoms of which will be connected by the three pipe lines. These will be laid about 7 feet below the bed of the river and about 16 feet below tunnel grade.

The new pipe line from the projected third reservoir to the city will duplicate the cast-iron line from the lower reservoir which has been in use more than twenty years. Work on this pipe line and the tunnel through which it passes has already been started. It is expected that within two years water from the Shepaug will be flowing into the city mains, but it will be several more years before the entire plan has been worked out, including the construction of the 100 foot dam across the Shepaug river.

Right Claimed to Use of Sewage

In arid sections of the country, water of any kind is valuable, and western ranchers in a number of cases have acquired the right to use sewage for irrigation and established these rights by law. This sometimes complicates the problem of designing sewerage systems when it might seem otherwise desirable to change the point of discharge. The construction of a sewage disposal plant for one Oregon city has been delayed nearly two years pending a court decision as to the point of disposal and the determination of the rights of certain parties to the use of the sewage.

The right to the use of the sewage from the city of La Grande, Oregon, had been acquired by certain ranchers who had used the sewage for several years for irrigation. Later, one rancher as well as members of his immediate family, also members of various families in the city to whom he sold milk from his dairy, contracted typhoid fever from the use of milk from this dairy, the dairy cows having free access to the sewage carried in the irrigation ditches.

Through court proceedings the rancher recovered monetary damages from the city; the jury, however, allowing only temporary damages and not permanent damages to the ranch, which the owner had asked for in his complaint. The jury held that the construction and successful operation of a modern sewage disposal plant would eliminate all possibility of permanent damages to the rancher or to his property.

At their first opportunity the people of La Grande voted the necessary bonds to construct a modern sewage disposal plant in order that the sewage might be returned in the form of water "undiminished in quantity and unpolluted in quality." This plant was completed last year at a cost of $105,000.

Exhibit Space at the 1928 Road Show

As stated in a previous issue, the convention and road show of the American Road Builders Association next January will be held in Cleveland, O. The building selected for the purpose is approximately 200 by 500 feet, and additions are being built at each end at an estimated cost of two million dollars. With these completed, there will be 45 per cent more exhibition space than at the Chicago Coliseum.

Chicago Sewage Treatment Plants

Main features of the Morton Grove, Glenview, Northbrook, Des Plaines River, and Calumet plants, now in service. Imhoff tanks, splash plate and sprinkler distribution trickling filters, activated sludge, fine screens, sludge presses and vacuum filter among features of the five plants

A general statement concerning the treatment of Chicago's sewage was given in the July, 1926, issue of PUBLIC WORKS. The following brings the information concerning the city's treatment works practically up to date, and gives further details concerning them.

MORTON GROVE, GLENVIEW AND NORTHBROOK WORKS

There are in operation the following: Morton Grove, designed for population of 1,200 with average flow of 180,000 gals. per day. Combined sewers. Two Imhoff tanks, maximum water depth 17.5 ft.; average detention period 2.9 hours; sludge digestion capacity 2.16 cu. ft. per capita. Covered trickling filter, two beds each 35 x 36 ft., stone 6.4 ft. deep; splash plate distribution system. Designed for rate of 3 m.g.d. per acre. Two secondary settling tanks, radial flow type, 10 ft. diameter, 8.25 ft. maximum water depth; sludge discharged to Imhoff tanks. Two under-drained sand beds, each 15 x 12.5 ft. (.31 sq. ft. per capita) for Imhoff sludge. Two motor driven, float operated pumps, each 300 g.p.m. capacity against 28 ft. head for pumping settled sewage to trickling filters; one 150 g.p.m. sludge pump, raising sludge to drying beds. Operating since 1914.

Glenview works; same general type as Morton Grove and designed for same population, but with one Imhoff tank of about 50 per cent more capacity than each of the other two, giving sludge digestion capacity of 1.5 cu. ft. per capita; trickling filter using spray nozzles, at rate of 2.6 m.g.d. per acre; one secondary settling tank, radial flow 16 ft. diameter and 10 ft. depth; two sand beds, each 14 x 22 ft., 0.5 sq. ft. per capita; and pumps of 125 g.p.m. capacity, with air compressor for pumping sludge. Operating since 1924.

Northbrook works: same general type, for 1,500 population and 180,000 g.p.d. capacity; Imhoff tank and trickling filter same dimensions as Glenview and pumping plant similar; sand beds 22 per cent larger. Operating since 1925.

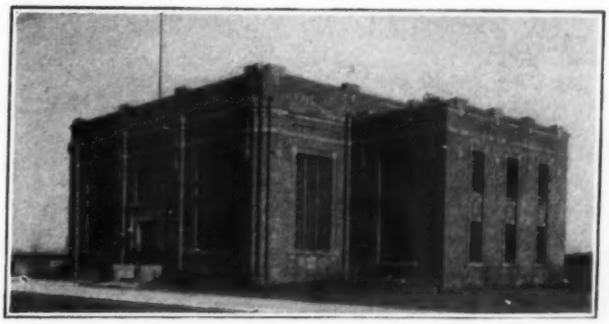
DES PLAINES RIVER WORKS

This was the first of the larger projects to be completed and the first permanent plant in the district to use activated sludge. It was placed in operation in August 1922 and has yielded valuable results that have influenced the design of later works, particularly the North Side plant. It treats the drainage from 12.5 sq. mi., and a present population of 64,000 dwellings in six villages and parts of two others. The sewage is almost wholly domestic.

Sewage is brought to the plant by an intercepting sewer which reaches a maximum diameter of 5 ft. 6 in. The sewage now averages about 5,620,000 g.p.d. The plant was designed for a maximum capacity of 6,500,000 g.p.d. and when the storm flow (the sewers are almost all on the combined system) exceeds this the surplus passes to the river.

The plant comprises two grit chambers and screens; four aeration tanks, each provided with a battery of three settling tanks, with an operating gallery between the aeration and settling tanks; six sludge concentration tanks; and sludge dewatering equipment.

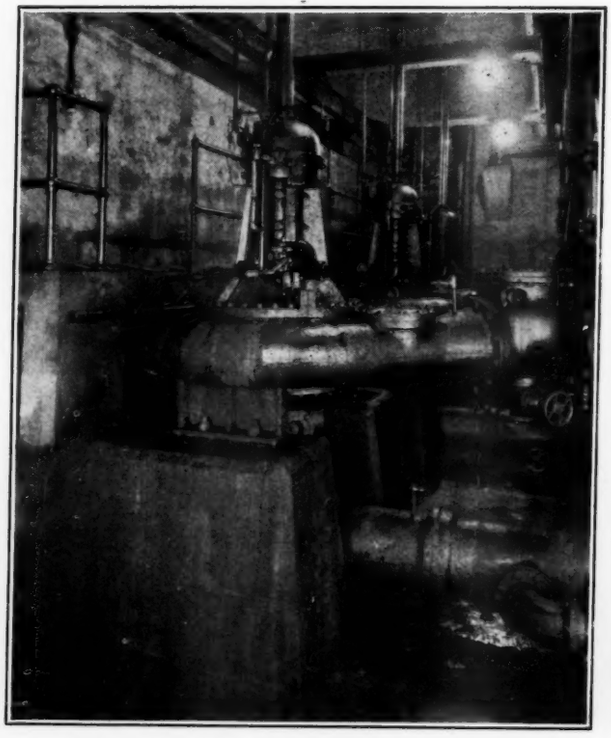
The largest building is the main pumping station and blower house, in which are three 14-in. sewage pumping units with space for two others, a venturi meter to measure the pumpage, six motor-driven



MAIN BUILDING, DES PLAINES RIVER WORKS

blower units for furnishing compressed air for the aeration tanks, air screens and an air washer; also the main electrical substation, repair shop, offices and chemical laboratory. The grit chambers and screens are housed in a one-story brick building, another covers the operating gallery, a third contains the sludge coagulants, the sludge dewatering equipment is installed in a two-story building 35 x 66 ft., and a one-story building 36 x 98 ft. furnishes accommodations for the men employed about the plant, garage space, and storage for dried sludge.

The interceptor enters the plant at such depth that the sewage must be lifted about 28 feet to the level of the tank system, which is submerged to about the ground line. Raw combined sewage commonly contains considerable solids, such as leaves and twigs of trees, hair, string, rags, cardboard, sticks, even tin cans and other household cast-offs, besides much street refuse. But installation of screens at the very deep intakes of the pumps would be expensive, as would cleaning them. The sewage therefore is pumped before screening, using Wood trash pumps of the Fairbanks-Morse Co.; a type of pump first successfully used for sewage pumping in New Orleans, and which has proved equally satisfactory at this plant. Three 14-inch vertical-shaft pumps arranged for self-priming are used, each with a capacity of 6.5 cubic feet per second against a head of 32 feet direct-driven by a 50-horsepower squirrel-cage induction motor at 400 revolutions per minute. Power is received from the Sanitary District's electrical distribution system at 12,000 volts, 60 cycles, three phase, and is stepped down in a main transformer bank to 440 volts, at which the motors operate. A switchboard, oil circuit-breakers and full complement of instruments provide for full control, recording and protection of power operations.



THREE FAIRBANKS-MORSE TRASH PUMPS

From the trash pumps the sewage passes through a Venturi meter which indicates and records the flow; then enters the screen house, where it goes through two coarse rack screens with one-inch clear openings, and next into the two grit chambers, each 44.5 ft. long, 3.5 ft. wide and 3.0 ft. deep, in which, at average flow, the velocity is 0.6 ft. per second, thereby causing sand and grit to be deposited. The grit chambers also permit skimming off oil or grease that may have entered the sewers and which cause trouble in the treating process if present in considerable quantity.

From the grit chambers the sewage flows through a Reinsch-Wurl rotating screen 14 feet diameter, with slots 1/16 inch by 2 inches. The screenings and the deposits from the grit chambers have been ploughed into the land at the rear of the plant.

Of the four aeration tanks, one is 21 by 126 ft. by 15 ft. deep and one 30.33 ft. by 126 ft. by 10 ft. deep; each with two passes giving a total travel of 256 ft. and with filtros plates arranged on the ridge and furrow system with a plate ratio of 1:5.7; and two tanks 30.33 ft. by 126 ft. deep, with four passes giving 503 ft. total travel, in one of which 323 ft. is for aeration and 180 ft. for reaeration of sludge and the air diffuser plates are as above, while the other was at first of the ridge and furrow type with separate reaeration of sludge but in 1924 was changed to the spiral flow type with air diffusers arranged in longitudinal rows and a plate ratio of 1:9. The plain aeration units provide for a detention period of approximately 4 hours at average flow with a 30 per cent sludge return, while that with separate sludge reaeration provides for a 2½ hour period of aeration for the sewage and 3 hours for sludge.

About 1.35 cu. ft. of air is used per gallon of sewage, which is less than required at several other activated sludge plants, but even this requires nearly five times as much power as is used by the pumps. In an effort to reduce this power to a minimum, different air diffusion schemes were tried. A tank equipped with inclined-surface baffles and with diffuser plates along one wall only was found to require about 20 per cent less air than the usual ridge and furrow arrangement, and this plan is being used in the North Side plant now under con-

GRIT CHAMBERS. COARSE SCREENS IN BACKGROUND

struction, thus effecting considerable economy in its power requirements. The greater depth used in one tank seemed to have no material effect on the efficiency of purification.

From the aeration tanks the effluent passes through the valve and control house to settling tanks and thence to the river. There are four batteries of 3 tanks, each 24 ft. square, two batteries with hopper bottoms and two with sludge-cleaning mechanisms of the Dorr type. The latter has proven better in service and has been adopter for later plants.

About 10 percent of the sludge drawn off by the air lift pumps is dewatered in the press and dry house and dried for fertilizer, and the product, from one to two tons a day, is sold in bags at $22.50 per ton f.o.b. cars in carload lots.

The sludge dewatering equipment consists of a Berrigan press with 80 4x6 ft. filter bags; a Worthington press with 22 4x6 ft. bags, and an Atlas dryer with a drum 30 ft. long and 48 in. diameter. The Berrigan press has a capacity of 20,000 to 30,000 pounds of pressed cake (about 80% water) per day and the Worthington press 8,000 to 10,000 pounds. In cold weather coagulation previous to filtering is aid by adding sulphate of alumina to the sludge, and experiments are being conducted with ferric chloride and other chemicals in the hope of obtaining still better results. The filter press cake is broken up and carried by a flight conveyor to the Atlas dryer which is heated externally and internally by hot gases from a coal fire. This evaporates 1,000 to 1,300 pounds of water per hour with a consumption of 250 to 325 pounds of coal, leaving but 10 per cent moisture in the sludge. The dried material is then passed through a crusher which reduces it to particles passing an eight-mesh screen. This product is stable, free from odor, and contains about 5 per cent nitrogen.

THE CALUMET WORKS

This plant was placed in operation a month after the Des Plaines plant. It has a capacity for 56 million gallons a day, which may be reached about 1932. The present installation is an Imhoff tank plant, but two activated sludge units with apparatus for dewatering the sludge, and a small trickling filter are provided for experimental purposes.

The sewage passes through a 72 x 36 in. Venturi meter to the grit chambers, of which there are five, each 60 x 6.5 ft. by about 5 ft. depth of flow; velocity 0.8 foot per second; each preceded by a coarse screen with 1-in. clear openings.

There are thirty Imhoff tanks, each 103.5 x 34.5 feet, with a maximum water depth of 26.4 ft.; detention period in settling compartment, 2.9 hours; sludge digestion capacity 2.3 cu. ft. per capita. One unit is provided with gas collectors for experimental work on gas production from the digestion sludge.

There is 3.5 acres of sludge drying beds, or 0.7 sq. ft. per capita. Sludge is removed from some of the tanks by pneumatic ejectors. Dried sludge is shoveled up by hand and hauled to a dump by gasoline locomotive on industrial track. Two beds have been covered with glass, greenhouse type, for experiment. An experimental machine for mechanical cleaning of sludge beds is being tried out.

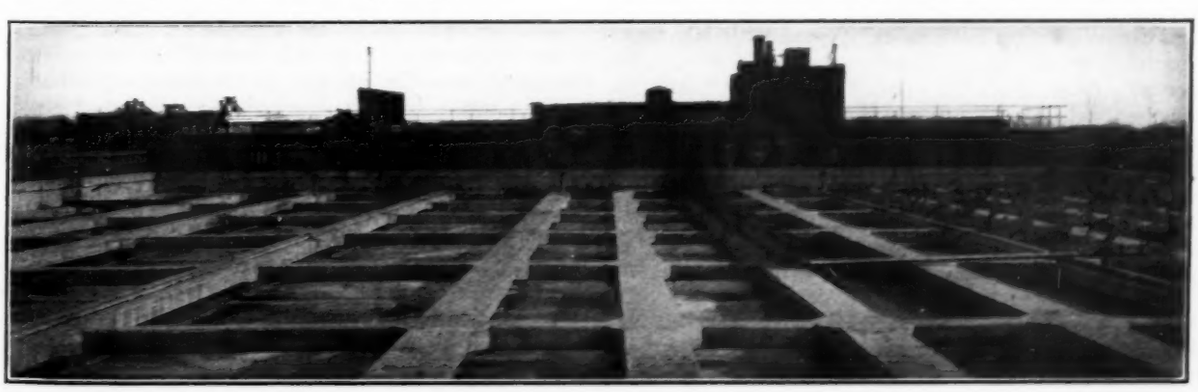
The trickling filter is fed by spray nozzles at an average rate of 2.4 to 3.5 million gallons per acre daily; depth of stone, 6.58 feet. The secondary settling tanks, two in number, are radial flow, 30 feet diameter, maximum water depth 20.2 feet.

Each of the two activated sludge units is 103.5 by 34.5 feet, with 14.3 feet depth over air diffuser plates, which are set in a ridge and furrow system with a ratio of 1:4.21.

One of the activated-sludge units operates on raw sewage taken from the grit chamber; the other on the partly clarified sewage taken from one of the Imhoff tanks. The sprinkling filter treats similar sewage from another Imhoff unit. The object of these various treatments was to determine their comparative efficiencies by themselves and in combination. Activated sludge combined with preliminary sedimentation gave results comparable to the tank-sprinkling-filter combination. Both these give high-grade effluents compared to the Imhoff tank alone. As the area served by this project becomes more populated, it is planned to add secondary treatment to the effluent from the Imhoff tanks.

Air for aeration is supplied at 8 pounds pressure by four motor-driven Nash hydro-turbine type blowers with a combined capacity of 6,450 cu. ft. of free air per minute; and a similar blower supplies air to air lifts and sludge ejectors.

In filtering the sludge from the activated-sludge units at the Calumet plant there is used an Oliver continuous rotary vacuum filter. This has a drum 11.5 feet in diameter and 14.5 feet long, slowly rotating once in 15 minutes in a tank of sludge. A slight vacuum within the drum draws the liquid through its cylindrical cloth surface, leaving a thin layer of 80 per cent moist sludge on the surface, from which it is scraped off and later dried in an



GENERAL VIEW OF AERATION TANKS

Atlas rotary drier of the same size as that at Des Plaines. There are two sludge concentration tanks for conditioning sludge prior to dewatering, each holding 18,000 gallons.

The treating capacity of the plant is 56,000,000 gallons of sewage per day. Since the average dry-weather flow is approaching this, extension of the plant will soon become necessary. Construction cost of the treatment plant proper has been in round numbers $6,125,000; of the associated interceptors, $5,000,000; of Calumet pumping station, $1,500,000; and of the standby power plant, $1,175,000. Extension of the plant and additional interceptors will involve an outlay of about $5,000,000.

The North Side and West Side treatment works, now under construction, will be described in our September issue.

Concrete Road Deterioration Data

Conclusions as to joint spacing, center joints, variations in aggregates, reinforcement, subgrade conditions, and pavement thickness, from survey of twenty-five hundred miles of concrete roads

During the year 1926 a survey was made of about 2500 miles of concrete roads in the New England states, New York, New Jersey and Delaware, special attention being paid to joint spacing, aggregates and mixes, reinforcement, subgrade and slab depth, and the present condition of the road, with the purpose of learning in what way and to what extent the last has been affected by the other items named. The data obtained were embodied in a full report made to the Association of Highway Officials of the North Atlantic States at its annual convention. By including an extensive mileage scattered over nine states it was thought that variations due to differences in traffic, aggregate used and engineering control would to a large extent be eliminated in the averages.

The practice with reference to joint spacing is not uniform. New York spaced joints 40 feet apart; New Hampshire 50 feet; Vermont 50 to 60 feet; New Jersey 56 feet; Massachusetts 60 feet; Rhode Island 100 feet, and Delaware, the day's run. It was found that on fifty miles of road with 100-foot spacing the combined length of joints and cracks per mile of road was less than on roads with shorter spacing and less than joints alone with slab spacing of 40 feet. There therefore seemed to be no argument for a spacing of less than 100 feet; while on the other hand each additional joint increases construction difficulty and cost, number of planes of weakness and of corners, where breaking under impact is most common.

Cracks in modern center joint pavements are not so numerous as in the old full-width slabs, do not open so wide, and there are fewer diagonal ones. Where diagonal cracks are found in the narrow slabs they are more probably indicative of poor concrete than are similar cracks in wide slabs.

The conclusions reached relative to aggregates and mixes were that the sand used is more variable in quality than is the coarse aggregate; that if under proper control neither natural nor washed sand excells the other, but if not controlled, sand is the greatest factor in scaling; that there is, in all cases, less scaling on gravel than on broken stone roads, but that good workmanship can prevent scaling with any aggregates; that up to the point where age or traffic weight begins to overcome pavement resistance, many gravel pavements stand up as well as or better than those of broken stone, but beyond that point average gravel concrete does not show the strength and durability of broken stone concrete, and there is more likelihood of the aggregate being unsuitable when gravel is used than when broken stone. True scaling is a flaking off of integral flakes of mortar up to ¼ in. thick, but there is also a sloughing away of the surface which is a beginning of complete disintegration and which can readily be avoided. True scaling may be due to fine or dirty sand; coarse aggregates which are too large, or ungraded, or coated or with flinty surfaces; to too much cement; to over-manipulation or late finishing; or to frost.

Reinforcement seemed to have proved its value on these roads, but not that it will prevent rapid deterioration or failure if depth or strength is inadequate. It does not seem to prevent cracks that appear during setting and seasoning, but does prevent the widening of these and destruction of cracked corners. Reinforcement at 40 lb. per 100 square feet or just above this appeared to be as effective as heavier types up to 120 lb.

Among subgrade conditions that resulted in damage to concrete pavements were mentioned culverts with shallow cover; fills at bridge approaches; uneven rock surface, particularly on heavy grades; and old stone roads. No remedy was found for shallow cover over culverts except to deepen it. At bridge abutments the last slab on the approach should be extra thick and reinforced. On ledge subgrade a 6-in. gravel sub-base well drained is recommended. When old stone roads are used as subgrade they should be broken up and reshaped or a cushion layer of 6 inches of gravel be placed on them. For wet or clay subsoils, gravel or cinders or other porous filling at least 6 inches deep is recommended, drained to the side ditches or otherwise.

From comparison of the amount of cracking and corner breaking with the thickness of the pavements examined, and the results of the Bates, Pittsburg and Arlington tests, it was concluded that for average present conditions of traffic a depth of approximately 7 inches of concrete is necessary, and a 6-inch pavement will not withstand present truck traffic. Also that, this being the case, and assuming that, as an engineering structure, a pavement should have a factor of safety of at least two, gives 10 inches as the desirable depth; which depth is recommended for all trunk lines where intense truck traffic and severe winter conditions may be expected. Regardless of traffic, a minimum of 8 inches is recommended where winter conditions are severe.

Material Handling Equipment and Cost

Relative use by contractors of the various types and average costs per ton of transferring materials from cars to bins

Information furnished by manufacturers of equipment and many contractors throughout the country has been analyzed by R. Petersen, of Henry Horst Company, Rock Island, Ill., in an article in "Public Construction News" and summaries made of data relative to the kinds of equipment used in handling material and relative costs. A brief abstract of his discussion is given below.

"The various types of equipment used for unloading purposes can be briefly summarized as follows:

1. Hand unloading.
2. Belt and bucket conveyors.
3. Derricks,—stiff-leg and full-circle.
4. Locomotive cranes.
5. Caterpillar cranes.
6. Bucket loaders.

"All of the above types of equipment, excepting the bucket loaders, are supplemented by some kind of unloading bin with proportioning hoppers. With the equipment described above, material can be handled satisfactorily from the cars to the stock piles or to the bins, from which it is proportioned and passes on to further job operation."

The data collected show that, of the contractors represented, 77 per cent. used cranes of various types; 60 per cent. used hand unloading methods; 32 per cent. have used derricks; 26 per cent. locomotive cranes, and 24 per cent. conveyors and bucket loaders.

The reported average initial costs and estimated lives of the several kinds of equipment he gives as follows: Locomotive crane, $14,000 cost and 7 years life; caterpillar crane, $10,000 cost and 6 years life; derrick, $5,000 and 9 years; conveyors and bucket loaders, $4,500 and 6 years.

Mr. Petersen obtained figures of cost per ton of handling materials from cars to bins, including depreciation, labor, fuel, oil and supplies. Averaging these, he finds the cost of unloading by hand 26 cents per ton; with bucket and conveyor 20 cents; with caterpillar cranes, 15 cents; with derricks, 14 cents, and with locomotive cranes, 14 cents. He recognizes that sufficient data are not available to establish undisputed cost, "but the information can be looked upon as fairly representative, keeping in mind that each individual unit will fluctuate widely because of many variable conditions prevailing at the plant site.

"Preference expressed by the reports of contractors gathered by the author indicates that 77 per cent. prefer cranes, with the majority favoring gasoline power; 14 per cent. have chosen locomotive cranes; 6 per cent. are partial to derricks and 3 per cent. prefer the use of conveyors and bucket loaders. The factors influencing the choice of the majority for cranes are as follows:

(a) Flexibility in operation and use on other work.
(b) Ease with which set-up can be made.
(c) Comparative economy in cost of operations.
(d) Capacity and control of stock piles."

From his study of the subject Mr. Petersen draws the following conclusions:

"First conclusion: There is an apparent tendency among the contractors to standardize on gasoline cranes with clam-shell buckets having load capacities of three-quarter yard and one yard. This equipment is plainly the choice of a majority.

"Second conclusion: That the relative merits of unloading equipment is controlled by:

"First, the physical conditions surrounding the plant site.

"Second, the equipment already owned by the contractor.

"Third, the human element which enters into the operation of the equipment.

"Fourth, the character built into the equipment itself by the manufacturer.

"Fifth, and last of all, but not least, the initiative the contractor possesses and expresses in the use of his equipment."

Waterproofing a Concrete Dam

Effected by applying alternate layers of wool felt and asphalt membranes and gilsonite fluxed asphalt

A large part of the storage utilized in connection with the water supply of Salt Lake City is retained in what is known as the Mountain Dell storage reservoir, formed by a dam built across Parley's creek. This dam was built in 1917, of reinforced concrete of the Eastwood multiple arch type, 370 feet long and rising 110 above bed rock, giving a reservoir capacity of 273,700,000 gallons. It was planned, however, to raise the dam 40 feet higher, which would increase the storage capacity to 945,000,000 gallons, and this was done in 1925.

WATERPROOFING MOUNTAIN DELL DAM

Following the forty-foot raise in the reservoir level, it was found desirable to waterproof the old part of the dam and this was done during October to December of last year by the Galigher Machinery Co. under contract. This waterproofing consisted in placing a membrane on the upstream face. Preparing the deck for the reception of the membrane was done by the city, and consisted of chipping and brushing the surface to remove all the scale and loose material, and smoothing out all irregularities as far as possible. The notches at the intersections of the arch rings and corbel heads were filled with concrete to provide a curved surface for the membrane connecting the arches.

The first operation of waterproofing consisted of heating the surface of the concrete by means of kerosene torches. The thorough heating and drying of the surface was immediately followed by the application of a primer coat using approximately 10 pounds per square. Next a flood coat of approximately 50 pounds of gilsonite fluxed asphalt per square was applied. This was followed by successive layers of pre-formed membrane and gilsonite fluxed asphalt mopping courses, the moppings weighing approximately 40 pounds per square. Three layers of pre-formed membrane were used, this part of the work terminating with the mopping course. The pre-formed membrane consists of all wool felt envelopes filled with gilsonite fluxed asphalt. It is made up in sheets 3 ft. x 5 ft., is about ¼ inch thick and weighs 150 pounds per square. The membrane was heated before placing and was thoroughly hammered into place with wooden mallets to insure adhesion at all points. A cap sheet of wool felt was placed on the last mopping course above mentioned. This was covered by a mopping course working from the bottom to the top of the dam. In order to take care of any abrasions in the mopping course last mentioned a final flood coat was applied working from the top to the bottom.

The total thickness of the waterproofing is somewhat over one inch and the weight per square about 670 pounds. The membrane was keyed at the top, sides and bottom by beveling off the edges and then placing alternate layers of asphalt and asphalt saturated cotton fabric strips. Four strips of fabric were used, the first being nine inches wide and the last twenty-eight inches wide.

The contractor commenced work September 28th. The work was completed December 1st.

The lower bays were filled with earth to an elevation 5 feet above the bottom of the waterproofing membrane as a protection to the concrete below the membrane. Tile drains were laid from the back face of the arches to the face of the fill.

The cost of the waterproofing and backfilling was $19,209.

Assessment of Cost of Paving Street Intersections

State legislatures may place cost on either taxpayers or abutting owners, apportion it between them, or leave this to discretion of municipalities. Court decisions on doubtful or disputed points

By John Simpson

The question of who is to bear the expense of paving the intersections of streets which are to be or have been improved depends primarily upon the statute authorizing the improvement. It is within the discretion of the Legislature to place the cost upon the taxpayers in general, or upon the owners of the property abutting on the improved street, or to apportion it between the city and the abutting owners. The Legislature may make the method mandatory, and if the method of assessment is prescribed by the statute, that method must be followed strictly. It may, on the other hand, leave the matter to the discretion of the municipal authorities, and in that case the ordinance authorizing the improvement will govern. The determination of each case, therefore, necessarily depends upon the language of the statute or the ordinance, or of both.

A recent decision on this point in Kentucky, based upon an ordinance whereby the city was required to construct all the street intersections forming part of a street construction improvement at the expense of the city, from funds derived from taxation generally, held that the interest of all the taxpayers is involved, and ordinances and contracts for the construction of the streets can be validly enacted and entered into by the municipality only when done in accordance with the statutory authority therefor. As the Kentucky statute in question required two weeks to elapse between the passage of an ordinance for a street improvement by two boards of the city council, the ordinance was invalid where this time did not elapse, and also the contract resting on the validity of the ordinance, notwithstanding that all the abutting owners had petitioned to have the streets constructed at their expense. City of Ashland v. Steele, Kentucky Court of Appeals, Nov. 30, 1926, 292 S. W. 1098.

The assessment, it is held, must be levied pursuant to the law in force when the assessment proceedings were initiated and consummated, and not the law in force at the time the improvement was ordered. Minnesota Transfer Ry. Co. v. City of St. Paul (1925) 165 Minn. 8, 205 N. W. 609.

In this article the author has analyzed decisions rendered in many jurisdictions, arranging them in the following order: Cases where the cost has been placed upon the abutting owners; where it has been placed upon the city; cases dealing with the apportionment of the cost among abutting owners. Also, several cases dealing with the question of imposing the cost upon intersections.

ON OWNERS—DISCRETION OF MUNICIPAL AUTHORITIES

The Pennsylvania Superior Court holds, Altoona City v. Langlin, 73 Pa. Super. Ct. 483, that an ordi-

nance enacted under the authority of the Act of June 27, 1913, P. L. 582, art V, section 3, clause 10, which gives the city power to pave the streets and to charge lot owners therefor, includes also the street crossings and the intersections. The city had the right, and it was its purpose, as clearly expressed in the ordinance (which provided that the costs and expenses were to be assessed on the owners of the real estate bounding and abutting on the avenue to be paved, according to the "foot-front rule,") to make the abutting owners pay all the expenses incident to the improvement.

The West Virginia Supreme Court holds, Hager v. Melton, 66 W. Va. 62, that a city charter imposing special assessments for street improvements and providing that two-thirds of the total cost of grading and paving any street or portion thereof shall be severally charged to the owners of land abutting thereon in such proportion as the frontage in feet of each owner's land, so abutting, bears to the total frontage of all land so abutting, authorizes the inclusion and apportionment, in the estimate, of the cost of paving street intersections or crossings.

Where the charter of a municipality authorized the pavement of streets and the levy of assessments against abutting property to pay therefor, it was held that an assessment for street paving was not void because it included the pavement of the intersections of cross streets not abutting on the property of the individuals whose property was assessed; nor was such assessment void because it embraced the cost of pavement of certain streets fronting on property of the city. Kaplan v. City of Macon, 144 Ga. 97, 86 S. E. 219; Faver v. Mayor, etc., of Washington, (Ga.) 126 S. E. 464. The former case holds that in assessing the entire cost of paving a street, intersections and alleys may not be deducted.

Kentucky Acts 1920, c. 134, amending Ky. St. section 3643 by striking therefrom the words: "The cost of constructing or reconstructing the intersection or crossing of streets, avenues and highways shall be at the expense of the city," are held to remove from section 3643 all provisions putting the cost of constructing or reconstructing street intersections and crossings on the city alone, and confers upon the city council the same authority to assess the cost of paving of street intersections and crossings against the abutting property as it has to assess the cost of paving streets generally. Lawson v. City of Greenup (Ky.) 232 S. W. 383.

Where the municipal authorities have the power of exercising their discretion as to whether they will include or exclude the cost of street intersections when making an assessment on the abutting owners for the paving of a street, they will not be prevented from levying assessments therefor even though they have in the past paid for the same kind of paving improvement by general taxation. So it was unsuccessfully contended that the cost of the street intersections was included in the assessment for one street paving improvement while the cost of paving the intersections in other street paving improvements was paid by general taxation, with the result that the owners of the property abutting on the first mentioned street paid all the expenses of paving the intersections in that street and at the same time helped to pay for the intersections in the other improved streets. Colby v. City of Medford (1917) 85 Or. 485, 541, 167 Pac. 487.

In Lightner v. City of Peoria, 150 Ill. 80, objection was made that it was unjust to assess the entire cost of curbing and paving a street, from the upper line of one street to the upper line of another, including in such cost the intersections, upon the contiguous property. The court said that this contention, if addressed to the city council, might seem entitled to grave consideration. The council, hower, was expressly authorized by statute to determine that the improvement should be made and paid for by special taxation of contiguous property, and there was no evidence of an abuse of discretion on its part. "True," the court said, "they require the expense of paving the street intersection to be paid by special taxation of the contiguous property; but the paving of the intersections is necessary to the continuity of the improvement and to the benefit derived therefrom by the contiguous property, and if, as must be presumed, the benefit to the contiguous property is equal to the cost of the entire improvement, including the street intersections, there is no impropriety or injustice in the imposition of the tax. Ordinarily, perhaps, the paving of the street intersections, presumably being *pro tanto* an improvement of intersecting streets, has been paid for out of the general revenues of the municipality. But such intersecting streets may not require paving, or if requiring it may never be paved, and while there may be resulting benefits from the improvement, diffused, to the same extent, to sub-adjacent property, the special benefit contemplated and authorizing the special tax will accrue to the property contiguous to the street improved. It follows, necessarily, that the municipal authorities may require the special benefits accruing from the improvement to be assessed upon the property thus specially benefited, or may impose the same by way of special taxation, the two modes differing only in the manner of ascertaining the benefits."

In City of Kankakee v. Illinois Central R. Co., 258 Ill., 368, it was contended by objectors to an ordinance for paving parts of an avenue and a street to be paid for by special taxation of the property contiguous to and abutting thereon, by foot frontage, that in the improvement of streets to be paid for by special taxation the law contemplates that the municipality shall pay for the improvement of street intersections. The court, however, said: "In such case the city council has the sole power of determining whether the improvement shall be paid for wholly be special taxation or in part only, and if in part only, what proportion shall be paid for by special taxation and what proportion by general taxation. Land in the middle of a block is not contiguous to the street intersection but it is contiguous to the improvement, and all land contiguous to the improvement is properly assessed for its share of the cost of the whole improvement, including intersection of streets."

Where the charter or statutory authority gives a city general power "to determine what improvements shall be made at the expense in whole or in part of the owners of the adjoining contiguous or proximate property, or others specially benefited

thereby," but specifies no particular method of paying the cost of street intersections, it is held that the assessing power may assess the cost upon the property abutting the streets. Young v. Tacoma, 31 Wash., 153, (citing Creighton v. Scott, 14 Ohio St., 438; Cunningham v. Peoria, 157 Ill., 499; Conde v. Schenectady, 164 N. Y., 258; Burroughs, Taxation, p. 475). In Lewis v. Seattle, 28 Wash., 639, the city included in the assessment of such lots and blocks as the city council deemed would be benefited by a street grading improvement the cost of improving intersecting streets and alleys. It was held that the authority given by the act of 1893 (§ 6), empowering the city to assess the property "for an amount which shall not exceed the actual cost and value of the improvement," was sufficiently broad to authorize the city to include the cost of improving intersecting streets and alleys in the charge to the property benefited, and whether it would do so or not was therefore within the discretion of the city council to determine, and their action was not reviewable by the courts.

A provision of a city charter authorizing the assessment of the cost of improving street intersections on each block in such proportions as the common council should deem just and reasonable was held constitutional Mortz v. Detroit, 18 Mich., 495.

ON CITY—STATUTORY PROVISION MAY BE MANDATORY

Unless otherwise provided by statute, an ordinance may provide that the expense of paving cross streets intersecting a street ordered by ordinance to be paved shall be paid by the city. Moale v. Mayor, etc. of Baltimore, 61 Md. 224.

Under the provision of a city charter that where public improvements are chargeable on the lots benefitted, "all such improvements on cross streets and alleys" shall be paid for out of the funds of the proper ward in proportion to the width of the street or alley, it was held, Pier v. City of Fond du Lac, 38 Wis. 470, that, "where a street is improved across another street, the cost of the improvement in the line of such other street (which includes the crosswalks), is chargeable to the proper ward, and not to the corner lots."

Kentucky Statutes, Sec. 2833, provides that, if the territory to be charged with the cost of constructing a street improvement is bounded on all sides by principal streets, the cost must be apportioned among the lot owners in each one-fourth of the square contiguous to the improvement, and, if the territory contiguous to any public way is not defined into squares by principal streets, the ordinance providing for the improvement must state the depth on both sides "fronting" the improvement, which is to be assessed according to the number of square feet owned by the parties within the depth set out in the ordinance. It was held, Button v. Kremer, 114 Ky. 463, that the statute did not provide any mode of assessment for the improvement of a street intersection which was not surrounded by property bounded by streets, nor had any property fronting thereon, and hence the cost thereof must be paid by the city.

The Kansas act of 1867 in relation to cities of the second class provides that "for all improvements of the squares or areas formed by the crossing of streets, and for foot-walks across streets, the assessment shall be made on all the real estate within the corporate limits of the city." It was held, City of Lawrence v. Killam, 11 Kan. 499, that all such improvements of street intersections were chargeable to the city at large, and that this included the sidewalks at the corners of these squares as well as the paving and macadamizing at the centre.

But the provision of section 235 of the charter of the City of St. Paul, that nothing contained in the section should prevent the council from paying the cost of street intersections out of the general funds of the city, was held to be permissive, not mandatory. In re University Avenue, 150 Minn. 166, 184 N. W. 788.

The Iowa Supreme Court holds, Corey v. City of Ft. Dodge, 133 Iowa 666, that the fact that a city has by general ordinance provided for paying the expense of paving the street intersections and that portion of the streets in front of public property by assessments upon abutting property is not a bar to a subsequent determination to provide for the payment thereof by a general assessment of the entire property of the city.

(To be continued)

Cementing Porous Strata At Reservoir Sites

English practice of forcing thin grout into porous or seamy rock to prevent leakage under or around dams

There has come into use in England a method of prevention of leakage from reservoirs through porous rock under or around the ends of reservoir embankments, which was the subject of discussion before the Institution of Water Engineers in June. Formal papers were presented by Alfred A. Barnes and J. R. Fox and several other members added information; from all of which the following summary has been prepared.

As described by Mr. Barnes, the process consists in driving 4-inch or 5-inch bore holes to and through the porous rock which is or may become a medium of leakage under or around the ends of a dam or core wall. These are located in a line across the valley at or near that of the proposed core wall, primary holes at 90-foot intervals, then intermediate secondaries at 30-foot, and finally between these tertiaries at 15-foot. Through each hole very thin cement grout is pumped into the rock, mingles with the ground water that is passing through it and penetrates into a cone-shaped portion of the rock with the cone base 300 to 500 feet down stream from the hole. The cement gradually stops all pores and crevices and makes the rock impervious.

After the hole has been bored, the face of the rock wall is thoroughly cleaned so the grout can penetrate it, by forcing air to the bottom of the

hole through a 1-inch pipe with a nozzle on the end. After 20 or 30 minutes of this, a grout pipe is connected to the top of the hole and water pumped in under pressure, up to 75 to 100 pounds where necessary. Then cement is added gradually to the water until finally there is about one part cement to 15 parts of water. If made too rich, the thin grout will stop the pores near the hole and will not penetrate far enough into the rock or into the very fine pores. The cement should be slow-setting for the same reason; that used by him showed initial set in 3 hours and 10 minutes and final set in 5 hours and 5 minutes.

The grouting should be continuous, for should it commence to set or accumulate at all around the bottom or sides of the borehole it would prevent injecting any more grout there. If it is suspected that rock or grouting pipe is becoming choked, pump clear water rapidly for a time. If the borehole passes through two or more strata of impervious rock it is well to cement the first before boring down to the next; continuing the boring at once before the cement in the bottom of the borehole has set. Nothing but cement and water should enter the pipe unless leakage at the surface should appear, when sawdust may be added until the fissure is choked.

Large amounts of cement are necessary. At a job described by Mr. Barnes 496 tons was used for 24 bore holes, or nearly 1.4 tons per horizontal foot across the valley. Two three-cylinder grouting pumps performed the work in four weeks. When completed, a 6-inch capping pipe was inserted in the hole and covered with 1:5 concrete 30 inches deep. On work done for Birmingham, holes 101 feet deep and taking an average of 35.9 tons of cement per hole, cost complete $1,390, or $716.80 exclusive of cement.

The Birmingham work cost about $173,000, whereas carrying trenches six feet wide into the abutting hills would have cost probably more than $500,000.

The author believed that no reliance could be placed on this method for rock within 40 feet of the surface, as it is weaker and more broken up here and the effective sealing of fissures is impossible; but a trench for the core wall should be carried down to this depth.

Another member told of building a concrete dam in a narrow gorge of sandstone, heavily fissured and the fissures filled with clay. The end trenches were carried into the hills 12 or 15 feet beyond the line of high water and filled with concrete, an inspection shaft being left at each end. When the dam had been completed and filled a leakage of over a million gallons a day was found to be passing around one end. Eight boreholes were sunk into the rock here, some vertical and some 15 deg. below horizontal to reach the vertical seams, which were the worst offenders. The longest borehole was about 140 ft. long, nearly horizontal. As soon as a seam was struck in boring, it was grouted, the hole bored on to the next seam, and so on. This work stopped more than 99 per cent of the leaking, at a cost of $20,000, while carrying the trench far enough into the rock to effect the same result would have cost $125,000 to $150,000.

Soil Corrosion of Pipes

Pipes of iron, steel and ferrous compounds used for carrying water are subject to corrosion on both the inside and the outside. Corrosion on the inside is due to or affected by the water and substances carried by the water, while corrosion on the outside may be due to or affected by the soil in contact with the pipe. Comparisons of various kinds of metal as to their relative corrosiveness are frequently made, but in the majority of cases little if any reference is made to the nature of the soil in contact with the pipe, the assumption being that the differences are due chiefly if not wholly to the differences in material of which the pipes are made. An investigation now being carried on by the United States Bureau of Standards indicates that not sufficient attention has been paid to this matter of soil.

In 1922 the Bureau of Standards began an extensive study of corrosion of pipe in cooperation with a number of pipe manufacturers and public service companies. In carrying on the investigation, approximately 14,000 specimens have been buried in 46 different kinds of soils located in 32 widely separated localities. Up to date about 2,000 specimens have been removed for examination, while others will be removed from time to time during the next six years.

The materials under test include 20 varieties of bare iron and steel pipe materials, 24 varieties of non-ferrous metals, 17 kinds of bituminous coatings, galvanized pipe and sheets with 6 weights of coating, as well as two specimens each of lead and aluminum coatings. Some specimens were buried in alkaline soil, others in acid soil; one set is buried in a Louisiana swamp near an oil line which lasted about 6 years, where the soil is very wet; while another set lies in the muck of a southern city not far from a water line that has been subject to severe corrosion.

Some of the effects of burying noticed in removing specimens in 1926 were described by John D. Capron in a paper before the New England Water Works Association, from which the following information has been obtained. It appeared that in different soils the nature of the corrosion differs materially regardless of the material from which the pipe is made. From samples of which photographs were shown, it would appear that the nature of pitting and other forms of corrosion varied more widely with different kinds of soil than with different kinds of pipe material in any one soil. Comparing rates of pitting with hydrogen ion concentration of the soil in the case of 6 materials—wrought iron, pure open-hearth iron, Bessemer steel, open-hearth steel, copper-bearing steel, and ordinary cast iron—in 49 different soils, it appeared that the pitting rates of all the rolled materials were very similar in each of the several soils and the cast material showed similar tendencies altho deviating somewhat from the average of the rolled material. On the other hand, some soils gave pitting depths four to ten times as great as other soils. There did not, however, appear to be any direct relation between the hydrogen ion value of the soil and the rate of pitting. The same lack of relation appeared when

a study was made of the amount of soluble salt in the soil water and the corrosion. And the same was true of resistivity of the soil to electricity.

Mr. Capron suggests that the apparent lack of relation between soil characteristics and corrosions may be accounted for by the fact that the soil data were taken only at times when such specimens were being buried or removed, and that soil conditions may vary materially in the intervening period.

In connection with the investigation, the Government is making some laboratory studies, among them an elaborate series on the effect of size of grain of sand and the corrosion which results to pipe from contact with sand of these various grains containing a corrosive solution.

State Highway Bonds

A nation-wide survey has just been completed by the Bank of America, of New York City, into the bonded indebtedness of the several states. This shows that the total bonded debt of all the states amounts to $1,846,113,578, or $15.75 per capita. Of this amount, 45.2 per cent. was raised for the construction of highways and bridges, the actual amount of outstanding bonds being $834,467,058.

The largest bonded indebtedness of any one state is that of New York, $341,059,000 or more than 18 per cent. of the total. In per capita indebtedness, however, New York is eighth in the list, the per capita indebtedness being $30.17. The second largest state indebtedness is that of North Carolina, $143,392,600, or $50.17 per capita; while Illinois is third in total indebtedness with $137,212,500, or $19.04 per capita. Florida, Nebraska, Kentucky and Wisconsin have no bonded debt. South Dakota leads the list with an indebtedness of $85.15 per capita or more than five times the average for all the states.

Road Construction in Counties in 1926

Information from county officials giving sources of funds used for maintenance and construction and amounts so spent last year; also mileage of each kind of road improvement built last year and in service, with width of each

In the May issue we published tabulated statistics concerning highway construction and expenditures in about five hundred counties in the various states. Since those tables were compiled more than one hundred additional questionnaires have been returned, and the information given on these has been tabulated and is given in the following pages.

A number of the counties are still using less than ten per cent. of their expenditures for maintenance, while a number are using nearly or quite fifty per cent. for that purpose. Thirty-five counties reported all their expenditures were for maintenance. Averaging all of them, we find more than a third of the total was spent for maintenance.

State and County	Total Spent	Sources of Funds Used for Maintenance and Construction.				Amount spent on maintenance
		Local	State	Federal Aid	Other	
Alabama:						
Greene	$40,000	$5,000	$35,000	None	None	$30,000
Lee	75,000	40,000	35,000a	.....	.....	20,000
Winston	90,000	10,000	80,000	None	.....	10,000
Arkansas:						
Chicot	70,000	32,400	37,600	.....	.....	42,000
Marian	40,000	25,000	15,000	None	None	.....
Scott	30,000	8,000	22,000	.....	.....	8,000
Colorado:						
Boulder	221,586	146,839	32,375	.....	$42,372	184,294
Garfield	.....	.....	5,500	.....	.....	11,000
Florida:						
Palm Beach	1,593,964	.....	.....	.....	.....	.....
Illinois:						
Henderson	60,000	.....	None	None	.....	42,000
Knox	83,000	83,000	None	None	.....	20,000
Wayne	65,000	65,000	None	None	.....	15,000
Indiana:						
Lake	.....	.....	None	None	.....	276,879
Henry	243,000	243,000	.....	.....	.....	90,000
Wayne	175,000	150,000	25,000	.....	.....	175,000
Iowa:						
Cedar	72,789	16,347	None	None	.....	71,171
Cherokee	105,000b	.....	None	None	.....	83,000
Des Moines	80,000	55,000	25,000	.....	.....	49,000
Fremont	160,000	80,000	40,000	$40,000	None	30,000
Louisa	100,000	.....	80,000	None	None	46,000
Monroe	32,468	32,468	None	None	None	30,319
Kansas:						
Crawford	315,000	175,000	80,000	60,000	None	40,000
Ellsworth	123,938	81,625	42,313	.....	.....	.....
Hamilton	36,500	3,000	33,500	None	None	35%
Logan	85,000	40,000	30,000	6,000	.....	15,000
Montgomery	634,809	553,809	.....	81,000	.....	182,245
Osborne	131,880	.....	.....	11,924	.....	43,460
Shawnee	403,191	56,590	37,000	120,758	.....	188,842
Kentucky:						
Pulaski	20,000	.....	.....	.....	.....	Nearly all
Washington	38,227	.....	None	None	None	.....

State and County	Total Spent	Sources of Funds Used for Maintenance and Construction.				Amount spent on maintenance
		Local	State	Federal Aid	Other	
Michigan:						
Gogebic	165,814	100,000	55,000	10,000	.....	63,188
Van Buren	107,000	107,000	.....	.....	.....	58,000
Minnesota:						
Baudette	34,000	9,960	24,040	.....	.....	16,345
Cass	42,000	22,000	20,000	.....	.....	12,000
Grant	132,650	112,650	20,000	None	None	9,788
Kanabec	56,000	36,000	20,000	None	None	12,600
Lake	57,913	33,000	19,782	5,131	.....	20,000
Lincoln	74,080	54,390	19,690	None	.....	25,233
Nicollet	65,000	45,000	20,000	.....	.....	.....
Redwood	98,633	77,133	21,500	.....	.....	56,221
Mississippi:						
Lawrence	60,375	52,059	8,316	None	.....	60,375
Missouri:						
Callaway	40,000	40,000	.....	.....	.....	25,000
Lincoln	99,500	99,500	None	None	None	15,000
Marion	90,000	86,000	.....	.....	4,000	20,000
Ralls	60,000	60,000	.....	.....	.....	10%
St. Charles	179,306	179,306	.....	.....	.....	95,700
Montana:						
Hill	35,000	20,000	25,000	None	None	15,000
Nebraska:						
Chase	49,922	23,649	26,273	.....	.....	15,000
Grant	80,000	10,000	35,000	35,000	None	4,000
Thayer	90,000	50,000	25,000	20,000	.....	5,000
Washington	50,000	50,000	20,000	20,000	None	30,000
New Mexico:						
Socorro	100,000	55,000	25,000	20,000	.....	10,000
Taos	120,000	.....	70,000	30,000	.....	20,000
New York:						
Franklin c	437,000	235,000	82,000	.....	.....	120,000
Fulton	75,930	23,070	22,860	None	30,000	30,000
North Carolina:						
Nash	180,000	180,000	.....	.....	.....	20,000
North Dakota:						
McLean	192,873	96,428	32,148	64,297	None	13,444
Mountrail	85,000	40,000	20,000	19,000	5,000	10,000
Williams	59,632	59,632	None	None	None	25,000
Ohio:						
Logan	70,000	25,000	None	None	45,000	70,000
Paulding	210,000	73,500	20,000	.....	116,500	40,000
Ross	200,000	100,000	50,000	50,000	.....	6,000
Oregon:						
Columbia	289,728	268,428	21,300	.....	.....	79,279
Josephine	59,000	48,000	11,000	.....	.....	40,000
Polk	100,000	40,000	60,000	.....	.....	4,000
Pennsylvania:						
Somerset	561,993	280,000d	.....	.....	.....	10,000
South Carolina:						
York	130,000	130,000	.....	.....	.....	50,000
South Dakota:						
Clay	75,000	55,000	20,000	.....	.....	20,000
Codington	142,000	85,000	35,000	22,000	.....	21,000
Deuel	80,000	80,000	.....	.....	.....	.....
Faulk	84,866	62,091	17,696	5,079	None	18,460
Gregory	95,238	57,750	30,250	7,500	.....	22,750
Haakon	.....	.....	.....	.....	.....	7,930
Harding	20,000	17,000	.....	.....	3,000	5,000
Jackson	110,400	12,600	5,856	91,945	.....	8,456
Lake	35,000	.....	.....	.....	.....	10,000
Perkins	62,282	.....	11,036	None	6,034	12,867
Sturgis	.....	107,000	.....	.....	.....	14,000
Yankton	110,000	80,000	.....	.....	30,000	28,000
Tennessee:						
Warren	18,000	6,000	12,000	.....	.....	.....
Texas:						
Andrews	4,000	4,000	None	None	None	.....
Deaf Smith	30,000	30,000	None	None	None	17,689
Donley	38,000	32,000	6,000	None	None	36,000
Gaines	10,000	10,000	None	None	None	1,000
Kent	50,000	50,000	None	None	.....	10,000
Hockley	20,000	20,000	None	None	None	25,000
Lynn	15,369	15,369	None	None	None	15,369
Sutton	195,851	110,209	85,650	None	None	10,200
Washington:						
Grant	151,722	129,222	22,500	None	None	30,202
Island	55,807	30,807	25,000e	.....	.....	30,807
Kalama	300,000	266,000	34,000	.....	.....	260,000
Pierce	735,465	.....	.....	.....	.....	382,395
Clallam	181,437	159,437	22,000	.....	.....	150,000
San Juan	49,956	.....	.....	.....	.....	.....
Skagit	506,108	358,081	66,492	.....	.....	140,048
West Virginia:						
Gilmer	700,000	300,000	400,000	.....	.....	40,000
Wayne	600,000	.....	.....	.....	.....	40,000
Ohio	310,413	.....	.....	.....	.....	244,192
Wisconsin:						
Calumet	122,213	.....	4,468	41,116	.....	73,964
Forest	89,646	19,801	69,845	.....	.....	61,240
Langlode	108,458	.....	64,746	None	None	62,694
Manitowoc	380,553	233,553	105,000	42,000	.....	63,000
Marinette	134,079	65,000	52,509	.....	16,570	85,088
Milwaukee	922,501	625,752	250,415	46,334	.....	169,614
Wyoming:						
Johnson	19,892	19,892	None	None	.....	.....
Washakie	16,500	16,500	.....	.....	.....	60%

a—Includes Federal aid; b—from county and township tax; c—including 19 towns; d—state and township; e—gas tax.

Roads Constructed in Counties

State and County	Miles built in 1926	Total in use, end of 1926	Width of improved surface, ft.
BITUMINOUS CONCRETE			
Indiana:			
Lake	12	..	24
Henry	1	..	..
Oregon:			
Columbia	..	3	..
Washington:			
Skagit	..	11.68	24
Wisconsin:			
Milwaukee	..	3½	..
BITUMINOUS MACADAM			
Kansas:			
Crawford	..	4	18
Montgomery	4	..	18
Shawnee	..	4	18
Michigan:			
Gogebic	2	14	16
Missouri:			
St. Charles	..	10	16
New York:			
Franklin	12.5	..	14
Fulton	2.8	18	14
Ohio:			
Logan	..	5.7	16-18
Paulding	1.6	11	16
Oregon:			
Columbia	1	1	..
West Virginia:			
Ohio	1	..	..
CONCRETE REINFORCED			
Illinois:			
Henderson	..	18	18
Iowa:			
Louisa	..	1.5	..
Kansas:			
Montgomery	3	..	18
New York:			
Fulton	.06	.06	16
North Dakota:			
Pembina	4	..	..
Ohio:			
Logan	..	30	16-18
Paulding	..	10	16
Pennsylvania:			
Somerset	16	..	16
West Virginia:			
Wayne	1	1	18
BRICK			
Kansas:			
Crawford	..	5	18
Montgomery	2	..	18
Ohio:			
Paulding	..	5	16
Ross	4.3	..	20
Texas:			
Deaf Smith	3	..	30.50
Wisconsin:			
Milwaukee	..	1.2	24
WARRENITE-BITULITHIC			
Oregon:			
Josephine	..	34.5	..
Wisconsin:			
Milwaukee	5.94	5.94	20-24
ASPHALT			
Michigan:			
Van Buren	..	1	16-20
VIBROLITHIC			
Wisconsin:			
Milwaukee	2	5	18
AMIESITE			
Wisconsin:			
Milwaukee	1.42	1.42	18-24
CONCRETE—NOT REINFORCED			
Alabama:			
Lee	7	..	18-20
Colorado:			
Boulder	3	21	18
Kansas:			
Crawford	..	30	18
Shawnee	3.77	71.77	18
Michigan:			
Van Buren	2	42	16-20
Ohio:			
Paulding	..	5	16
Ross	1	..	20
Washington:			
Pierce	3.92	..	16
Skagit	3.5	89.7	24-30
Wisconsin:			
Calumet	..	12.5	18
Manitowoc	7	..	20
Milwaukee	7.05	240	16-18
GRADED ROADS			
Alabama:			
Lee	100	300	26-30
Winston	26	40	18
Arkansas:			
Chicoh	25	325	16
Marian	25	15	18
Scott	30	600	16-24
Colorado:			
Boulder	..	100	12
Garfield	5	1,500	12-24
Illinois:			
Henderson	..	400	30
Knox	10	40	26-30
Wayne	1,100	1,390	..
Indiana:			
Henry	..	475	..
Iowa:			
Cherokee	6.5	69	26
Fremont	2	28	28
Louisa	..	45	26
Monroe	24	65	24
Kansas:			
Crawford	12	..	28-30
Ellsworth	..	1,139	..
Logan	40	1,000	24-30
Montgomery	40	..	..
Osborne	12	48	28-30
Shawnee	6	120	20
Michigan:			
Gogebic	1½	52	16
Minnesota:			
Baudette	6	30.2	24
Kanabec	7	64	24
Lincoln	0.8	122.5	24
Nicollet	6	132	24
Redwood	4	211.3	24
Missouri:			
Callaway	200	1,300	..
Christian	15	..	18
Lincoln	35	540	26
Marion	400	400	20-30
Ralls	100	..	12-18
St. Charles	..	12	24
Montana:			
Hill	150	500	22
Nebraska:			
Chase	120	1,105	24
Grant	12	62	24
Hayes	300	600	..
Thayer	76	150	24
Washington	200	600	..
New Mexico:			
Taos	60	150	20
New York:			
Franklin	4	..	..
North Dakota:			
McLean	35.8	1,184	18
Mountrail	40	347	20-24
Pembina	28	..	..
Williams	72	777	24
Oregon:			
Columbia	10	100	..
Coos	48¼	..	..
Josephine	10	426	24
South Carolina:			
York	30	1,500	20-30
South Dakota:			
Clay	18	..	..
Codington	55	..	..
Deuel	24	..	..
Faulk	70	200	24
Gregory	8	292.5	24
Haakon	34	335.3	24
Harding	20	220	..
Jackson	38	397	20-24
Lake	25	976	24
Perkins	200	550	24
Sturgis	53	..	..
Yankton	22	22	24
Texas:			
Andrews	25	25	60
Donley	15	175	60

State and County	Miles built in 1926	Total in use, end of 1926	Width of improved surface, ft.
Gaines	30	100	20
Kent	50	..	..
Hockley	120	..	..
Lynn	40	500	40
Washington:			
Grant	36.5	192	16
West Virginia:			
Gilmer	14	50	22
Wayne	73	300	18-26
Ohio	1	..	..
Wisconsin:			
Forest	..	8	24
Langlade	13.75	250	..
Manitowoc	41	..	24
Marinette	25	..	24-28
Wyoming:			
Johnson	40	400	24
Washakie	7.5	..	16

SAND-CLAY AND TOP-SOIL

Alabama:			
Greene	..	100	20
Colorado:			
Boulder	20	361	18
Kansas:			
Ellsworth	8	20	..
Hamilton	27	30	28
Minnesota:			
Baudette	..	16	20
Cass	..	137.4	..
Missouri:			
Christian	15	..	..
Nebraska:			
Grant	4	12	..
Ohio:			
Logan	..	424	..
Oregon:			
Columbia	10	15	..
Josephine	10	165	24
South Carolina:			
York	50	500	26-30
South Dakota:			
Haakon	6	..	..
Texas:			
Donley	7	..	..
Washington:			
Island	..	60	..
Skagit	..	128	..

GRAVEL

Alabama:			
Greene	5	30	12
Winston	..	20	..
Colorado:			
Boulder	100r	222	18
Garfield	..	27	..
Illinois:			
Knox	1	..	..
Iowa			
Cherokee	6	22	26
Des Moines	4	..	..
Louisa	26	28	24
Kansas:			
Crawford	17c	100	22-26
Montgomery	2	..	..
Osborne	4	13	28-30
Shawnee	4	76.8	18
Michigan:			
Van Buren	7	157	9-16
Minnesota:			
Baudette	30	48	20
Cass	..	42.6	..
Kanabec	8	36	24
Lake	15g	..	..
Lincoln	27.1	122.5	24
Nicollet	4.5	125	24
Redwood	13	207.5	24
Mississippi:			
Lawrence	25	75	18
Missouri:			
Lincoln	16	320	26
Marion	31	245	10-24
Ralls	10	50	12
St. Charles	10½	57	10-12
Montana:			
Hill	..	50	24
Nebraska:			
Chase	6.7	..	24
Grant	10	10	24
Thayer	24	24	24
Washington	12	..	24
New Mexico:			
Taos	30	50	20
New York:			
Franklin t	5	..	12
Fulton	2.3	24.3	14
North Carolina:			
Nash	37s	126s	24
North Dakota:			
McLean	3	3	20
Mountrail	4	..	..
Williams	3	5	..
Ohio:			
Logan	..	425	..
Paulding	13.5	45	10
Oregon:			
Columbia	15	131	..
Josephine	2	84	24
Polk	15	..	..
South Dakota:			
Clay	2.5	..	..
Codington	16	..	..
Gregory	..	25	24
Deuel	12	56	..
Haakon	..	34	..
Jackson	..	22	..
Lake	..	96	..
Yankton	24	125	24
Tennessee:			
Warren	12	..	7
Texas:			
Sutton	30	..	..
Washington:			
Island	10	240	20
Clallam	28	468	16-22
San Juan	6	204	20
Skagit	3.5	..	24
Wisconsin:			
Calumet	13	230	16
Forest	..	3	24
Langlade	13.25	65	..
Manitowoc	41	..	..
Marinette	23.3	..	18-28
Milwaukee	..	15	16
Wyoming:			
Washakie	0.75	..	16

r—resurfaced; c—chatts; g—and graded; t—and towns; s—sand-clay and gravel. 19

WATER-BOUND MACADAM

Indiana:			
Lake	33	..	16
Iowa:			
Cedar	..	3	18
Kansas:			
Montgomery	1	..	18
Kentucky:			
Washington	5	..	14
Michigan:			
Van Buren	..	21	9-16
Missouri:			
St. Charles	2.5	5	..
Ohio:			
Logan	..	12	..
Paulding	8	30	10-16
Oregon:			
Columbia	75	200	20-24
Josephine	2	..	24
Polk	1	..	..
West Virginia:			
Gilmer	11	..	..
Ohio	1	..	..
Wisconsin:			
Calumet	..	250	12

New Rochelle Sewage Pumps

As part of a sewage disposal plant built a few months ago for the city of New Rochelle, N. Y., by the Fuller Construction, the engineers, Fuller & McClintock, included a pumping plant for discharging screened and chlorinated sewage into the bay. This is electrically operated and is automatically thrown in and out of service by means of floats, but with the additional feature that floats also regulate the speed of each of the two centrifugal pumps.

The pumps, each driven by a 40 h. p. slip-ring motor, are governed by a special General Electric control panel. The arrangement is such that either motor may be operated manually or automatically, separately or simultaneously. The panel controlling

the operation is automatically energized by means of five float switches, each one set at different water levels. When it is desired to operate automatically, either or both of the switches controlling the two motors are thrown to the "automatic" position.

The sequence of automatic operation is as follows: When the first float switch closes, the motors automatically accelerate to 80% of full-load speed and the water will be pumped at the minimum rate from the sump into the discharge line to the bay. Should the water in the sump rise faster than it is being pumped out, the second float switch will operate, bringing the pump motors to 85% of full-load speed. This continues as the water rises, each of the remaining float switches being actuated at its corresponding water level, increasing the pump motor speeds to 90%, 95% and 100% of full-load. The operation is reversed as the water level falls, the motors automatically slowing down as the water reaches each float switch level.

At each speed of the motors, a bull's-eye lamp is lit, indicating to the operator the speed at which the motor is running. When operating by hand, the control is first thrown to the manual position and, as soon as the "start" tumbler switch is closed, the panel automatically brings the motors to the 80% speed. The other speeds are obtained by throwing tumbler switches mounted on the board.

By adopting this method of speed control, the engineers found it possible to use a smaller motor and a smaller discharge pipe than would be required if the pumps were operating at the 100% speed only.

Brick Paving at Rockford, Ill.

The principal business thoroughfare of Rockford, Ill., South Main street, was repaved last fall with vitrified brick on a new 7-inch concrete base, by A E. Rutledge, contractor, under the charge of B. C Harvey, city engineer.

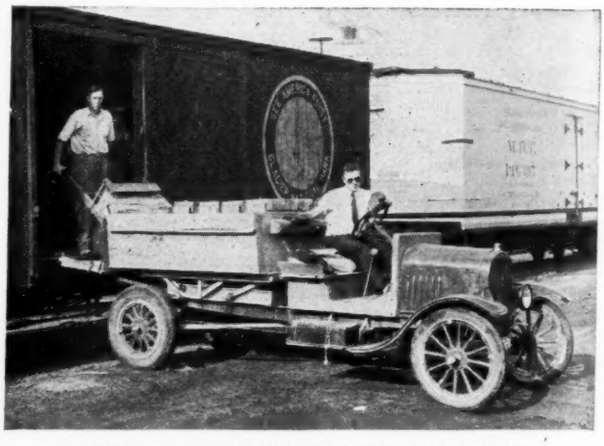
In this work the contractor used a new method of handling brick, requiring six less men than that commonly used and effecting a saving of about ten cents a square yard; also avoiding the necessity of piling the brick on the sidewalks. His plan was to build several wooden crates, each high enough to hold five rows of brick and wide enough to hold ten bricks to each row. The bricks were packed in these crates at the cars, and the filled crates were hauled to the job on trucks and placed in position for the brick droppers, being unloaded from the truck by wheelbarrows using a runaway built on a wagon body.

A concrete curb was constructed, of 1:2:3 mix, down the center of the street, which served as guide and template during construction and as a traffic marker. The curb was whitewashed before the asphalt filler was applied to the brick to prevent the filler from adhering to the curb.

The concrete base was mixed 1:3:5 (at some intersections 1:2:3), with only enough water to make it workable, and this material tested to 1534 pounds at 45 hours. A plain sand bedding course was used. Asphalt filler heated to 390° was applied by the filler pot method. Very careful inspection and insistence on a base with perfect surface alignment and smoothness secured an excellent pavement.

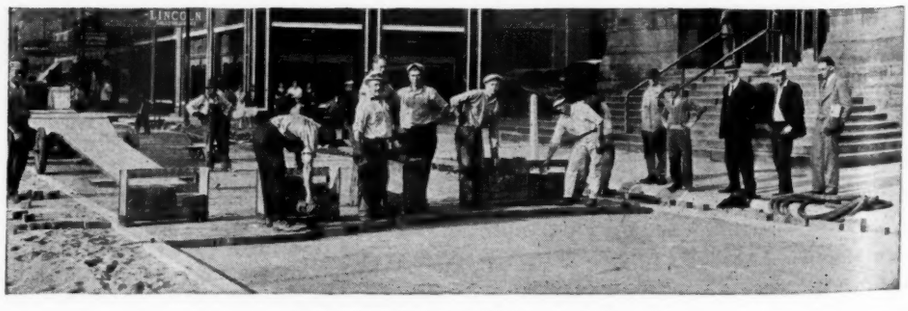
West Virginia Highway Bases

In our June issue, page 218, we stated that the West Virginia State Road Commission had, last year, changed the base thickness of its roads from 6" to 8" and 9". The context might lead to the understanding that this referred to concrete bases, whereas it was intended to refer to the broken stone or knapped stone base course. The concrete base courses remain at about 5".



UNLOADING BRICK FROM CAR IN CRATES

UNLOADING CRATES OF BRICK FROM TRUCK TO STREET



LAYING BRICK FROM CRATES

PUBLIC WORKS

Published Monthly
at 243 W. 39th St., New York, N. Y.

S. W. HUME, President J. T. MORRIS, Treasurer

Subscription Rates
United States and Possessions, Mexico and Cuba $3.00 year
All other countries..... $4.00 year
Single copies, 35 cents each
Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Longacre 8176
Western Office: Michigan-Ohio Building, Chicago
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Sanitary Engineering and the Flood

War as war is all that Sherman said of it; but it often furnishes by-products that go a long way toward compensating for its hellishness. The United States lost in battle in the Spanish American war only a small fraction of the number that died of typhoid and malaria. When the facts were known our sanitarians said "Never again," and in the World War our deaths from typhoid were but a small fraction of one percent of the deaths from fighting.

The knowledge, skill and technique acquired under the stimulus of the deplorable typhoid rate of the Spanish-American war serve equally well under many peace-time conditions. They have been employed during the past few weeks in guarding from epidemics the many thousands of refugees from the Mississippi flood who have congregated in temporary, often crowded and more or less make-shift camps. It is extremely probable that, but for the application to these refugee camps of knowledge obtained in safeguarding military camps, typhoid would have taken its toll of hundreds or thousands from the refugees crowded upon the levees and elsewhere.

What sanitary engineers have done, and what they are now doing to render the emerging cities, villages and scattered farms safe for reoccupancy is told briefly in an article in this issue. Blowing up levees, bucking the flood waters in frail craft and holding the inch-by-inch rise of the river with bags of earth assembled with strenuous labor night and day, are more spectacular, but it is doubtful if all of these combined saved more lives than the faithful, persistent, intelligent work of the sanitarians whose very existence received scant notice by reporters and is probably unknown to the public at large.

Montreal's Typhoid Epidemic

For twenty weeks a typhoid epidemic has continued in Montreal, Canada. Five hundred deaths and more than five thousand cases have been reported, and at this writing new cases are being reported at the rate of about six a day (in the middle of May the number exceeded 100 a day) and it is possible that there may be another rise before the final subsidence.

The collapse of a bridge or theatre that caused one tenth this number of casualties would call for and receive a most rigid investigation and a probable punishment of those responsible through carelessness or greed. If it were shown that, because certain influential politicians held considerable stock in the company which built the structure and, because of this, municipal inspection had been slighted and even infraction of building regulations permitted by municipal officials, these officials would be held morally responsible and an effort made to punish them legally.

For weeks after this epidemic got under way the city officials endeavored to suppress all news of it, presumably fearful that knowledge of it would keep out tourists and their cash, and utterly regardless of the fact that their visiting the city would subject them to risk of infection. At length the territorial government took a hand, and in June permitted the U. S. Public Health Service to make an intensive survey of the situation with a view to taking measures to prevent the spread of typhoid into the United States, of which there was and is very real danger. Representatives of the Health Service reported that up to the end of June the city authorities had not taken adequate measures to guard the milk supply, although local and provincial health authorities had weeks before traced the epidemic to this; and the local health department was still being handicapped

by the city officials in its efforts to control the epidemic.

It is hoped that the epidemic is on its final wane; but there will be danger of recurrence for months to come, for there are certain to be scores of carriers among the five thousand who recover, and infected water, undisinfected faeces, and other possible agencies of infection may exist in many places unknown or disregarded.

Probably thousands have left Montreal for United States cities, either visitors from this side the border or citizens fleeing the contagion, and there is danger that these may spread the epidemic into the northern part of this country. It is therefore desirable that United States cities, and especially those along the border, take the utmost precautions for the rest of this year. All handlers of milk and other food, cooks and waiters in restaurants, soda fountain attendants and the like should be examined and typhoid carriers eliminated. And United States citizens should, for the balance of this year at least, visit Montreal and vicinity only when absolutely necessary and then use the greatest precautions with regard to their food and drink, especially raw oysters, milk and water.

Another California Experimental Pavement

A test concrete road was built at Pittsburg, Calif., in 1921, through the cooperation of various private parties interested in highways and highway materials, and tested by the Bureau of Public Roads and the California Highway Commission. (See Public Works for October and December, 1921, January and February, 1922, and April, 1923.) One of the conclusions reached was the advantage of the thickened edge, which already had been adopted by California in 1912 as an alternate type, by Arizona a few years later and by Illinois in 1922. Another conclusion was the necessity of the greatest possible smoothness of surface.

This year another test concrete road has been built in California, of much greater length than the former and with the difference that this one is built and is being used for every-day highway traffic. Also, it was built by the State Highway Department. Another difference is that, while the Pittsburg road was made with 4-inch and 5-inch thicknesses, the Oxnard road has center thicknesses of 6 and 7 inches.

Among the details which have been varied in the different sections to permit comparison are the spacing of expansion joints and weakened planes, types of reinforcement, and methods of placing reinforcement. These variations are combined in different ways in thirty-eight sections.

Although traffic on this road is said to be heavy, it contributes undoubtedly but a fraction of the intensive wear to which other test roads have been subjected, and the time that must elapse before judgments can be formed will accordingly be many times longer. On the other hand, the traffic is real and not artificial, the pavement will be subjected to climatic changes of several winters and summers, and the conclusions reached may be accepted with more confidence.

Education of Engineers

Until comparatively recent years English engineers obtained their education almost exclusively by serving as apprentices or "articled pupils" to practicing engineers; and college training has by no means replaced this. At the May meeting of the Institution of Structural Engineers (England) a debate took place on the relative merits of articled pupilage and college training in the education of structural engineers. There seemed to be a general agreement that college followed by pupilage is the ideal plan, but few can afford the time and money involved. As between the two, possibly the arguments favored the pupilage plan.

Commenting on the subject, "The Surveyor" says editorially: "For municipal engineers, we regard experience in practical work as an absolute necessity; but it should be supplemented by preparation, either in class or otherwise, for an examination of such a practically useful type as that of the Institution of Municipal and County Engineers. In these days, every young municipal engineer who wishes to go far in his profession must supplement his office and outdoor work with study of the theoretical and scientific principles upon which that work is based."

Speaking along the same lines in a presidential address before the Society of Engineers (England), Douglas C. Fidler said in February, referring to correspondence on the subject in one of the professional papers:

"The gist of this correspondence was that the training is apt to be too theoretical and not sufficiently practical, and, of course, the contrary was also maintained. As usual, there is a good deal of truth in both aspects of the question, but it cannot be too strongly emphasized that the young engineer should not neglect the practical side for the purely theoretical. He will find when he takes up a chief appointment that a knowledge of common or garden office work, such as filing systems, the ability to write or dictate a clear and concise letter, to tot up a lengthy column of pounds, shillings and pence and get it right, to be able to estimate roughly the cost of a job without going into details, and perhaps above all the knack of getting the best out of men and staff without friction, will be far more frequently required than abstruse engineering formulæ or higher mathematics.

"I do not wish to be misunderstood. The time will come when he will need all his theory, but he is certain to need the practical or business side first and most frequently."

Removing High Bridge Piers

In razing an old covered bridge across the Chattahoochie river at Fort Gaines, Ga., built in 1860, the contractor was required by the U. S. Army engineers to so remove the five brick piers that no material would fall into the river channel. The piers measured 14 by 26 feet at the base and were 75 feet high. A dynamite expert was consulted and in accordance with his instructions three gopher holes were driven by hand approximately half way through the base of each pier; then a single hole was drilled

in each corner and also into the supporting centers, and 40 pounds of dynamite placed in each pier, primed with electric blasting caps and fired one after another. In each case the piers were overthrown in such a way that practically no debris was thrown into the river channel.

Refuse Disposal in Great Britain

Combined collection, incineration, and use of power therefrom are notable features. Typical plants at Eastbourne and Birmingham

Last summer H. W. Streeter, sanitary engineer with the United States Public Health Service, following his attendance at a meeting in Great Britain of sanitary engineers under the auspices of the League of Nations and the British Ministry of Health, visited a number of English cities where he made special observation of sanitary administration, water supply, sewage disposal, refuse disposal, and general sanitation. From what he learned at the meeting and these visits he prepared a report which has recently been published by the U. S. Public Health service in a pamphlet of 56 pages. In the following paragraphs we give an abstract of his observations on refuse disposal.

In the field of refuse disposal, the most impressive development observed was the successful large-scale application being made at Birmingham, Sheffield and other cities, of the incineration method combined with that of separaton. Other interesting features of British practice in refuse disposal were; (a)—The apparently universal custom of combining garbage and rubbish at the dwelling for collection and disposal; (b)—the ingenious uses made of power generated by incinerating refuse; (c)—the increasing sentiment against the "tipping" or "dumping" of crude refuse on land.

According to information supplied by the British Ministry of Health, the total amount of refuse (which includes garbage and both trade and domestic rubbish, but does not include street sweepings) collected by local authorities in England and Wales is approximately 12,000,000 tons annually, and the collection and disposal of this involves a yearly expenditure of about $39,000,000 or $3.24 per ton. The collection of refuse is almost universally undertaken by the local authorities, contract labor being confined mostly to certain small rural districts. The amount of dry refuse, though varying according to the local industries, averages about 1½ lbs. per capita daily. This gives an average cost of refuse disposal of approximately 80c. per capita per year.

Dry refuse is usually stored in small galvanized iron cans kept at the rear of the dwellings, the collection being made in some case daily but in more cases weekly.

There are five recognized methods of refuse disposal in Great Britain, namely, disposition on land; pulverizing or crushing, with subsequent use as fertilizer; incineration; separation; and disposal in tidal waters.

Tipping or dumping is widely prevalent but not generally approved, though permitted by the Ministry of Health with certain precautions, including that refuse dumps shall be formed in shallow layers, that all refuse must be covered with incombustible material, that distribution of debris by the wind must be prevented, and that no refuse shall be deposited in stagnant water.

The pulverization or crushing method involves passing the refuse through a disintegrator in which it is reduced to a coarse powder by means of hammers. During this process the refuse becomes thoroughly mixed and the final product is used as a fertilizer for heavy soils. The use of pulverized refuse in this manner does not cause the nuisances usually associated with the tipping of crude refuse.

In incinerating refuse, the crude refuse is burned in specially constructed furnaces, usually with a forced draft, until all of the combustible material has been consumed. No auxiliary fuel is ordinarily necessary, owing to the relatively small amount of wet garbage in the average mixed refuse. Frequently the heat generated by burning the refuse is used for the generation of steam for power purposes. The unburned residue, the volume of which is about one third of the original refuse, consists of scrap metal, which is drawn from the grate by hand; and clinker, which frequently is ground and used as an aggregate for concrete.

The separation process varies in different localities, but in general has for its object the removal of dust and, in some instances, the salvaging of certain valuable materials such as rags, paper, and metal, from the crude refuse. This method is frequently practiced combined with pulverization or incineration, either of these two processes being applied to the final residue.

The disposal of refuse at sea is practiced by a considerable number of towns along the seacoast. Hopper barges are used, varying in their capacities from 100 to 1,000 tons. The barges, some of which are operated under their own power, discharge the refuse in deep water at points designated by the authorities. The distances of these points from the shore vary from 3 to over 10 miles.

At Eastbourne is a good example of incineration by a small city. Here the refuse is brought to a central incineration plant located immediately adjacent to the low-level sewage pumping station, and is dumped into a series of hoppers from which it is fed into the combustion chamber of a six-cell incinerator. The refuse is burned under forced draft, without the addition of any supplementary fuel, and the heat thus generated is used to operate three water tube boilers which supply steam at a pressure of 100 pounds, which is converted into electric power and utilized for pumping all of the low level sewage and storm water. Scrap metal is removed by hand from the grates as it accumulates and is disposed of separately. The residual clinker is ground and utilized as an aggregate for concrete curb stones and slabs. Data for the year 1922 showed that the amount of refuse burned total 1.55 tons per house or 0.25 ton per capita. The costs of collection and incineration, including interest and

sinking fund charges, were $2.80 and $1.58 per ton or 70c and 39c per capita, respectively.

Birmingham in 1926 had an estimated population of 961,222. This city practices the separation method of refuse disposal on a large scale and efficiently. For purpose of refuse collection the city is divided into eight districts. The collection service in each district is organized according to a series of routes, so that each house visited has its definite place on the working list. If the collectors are unable to obtain access to a particular place, a card is left informing the owner of the day of the next collection. At the end of each day the collector reports the last address visited on his route and a progress chart is maintained showing the number of houses visited. By the aid of this chart, which also shows the average weight of refuse per load, the district inspector is able to determine exactly where the collection is in arrears, to allocate spare collection service accordingly, and to discover any slackness on the part of individual collectors.

Up to the year 1918 refuse was collected entirely with horse-drawn vehicles, but the continuous system above described could not be operated economically with horses and since 1918 more than 70 electric vehicles have been put into service with capacities varying from 7 to 13 cubic yards. The salvage department still employs over 100 horses.

The refuse is disposed of at ten plants but it is planned to reduce the number to eight, one for each collection district. Two of the largest of these plants, known as the Brookvale Road and the Tyseley plants are regarded as the best equipped ones of their type in Great Britain. Operation of these plants is as follows:

After being weighed in the collection trench, the refuse is hauled by trucks up an inclined roadway onto an elevated platform, where it is dumped into large hoppers. From here it is taken by a series of automatic feeders and delivered to cylindrical screens, which remove the fine dust and deposit it in hoppers underneath the screens, whence it is removed by a pneumatic conveyor to barges which transport it to a prepared dump or other place of disposal. The screened refuse passes through a cylinder having a magnetized section which automatically removes all metal pieces and deposits them in a hopper, whence they are conveyed automatically to a metal cutting and baling plant. The remaining refuse is carried to the incinerators by belts from which miscellaneous articles of value are removed by hand picking, waste paper being removed automatically by a suction apparatus which delivers it to a baling plant.

Among the by-products of this process which have a definite commercial value, are: rags, paper, scrap metal, tin, clinker and steam power. Rags are sterilized, laundered and sold for various purposes. Paper and scrap metal are baled and sold to paper and iron industries. When the market conditions are favorable, tin is recovered by a special process from waste metal cans. The clinker is ground, screened into various sizes and used as an aggregate for concrete. The steam power is converted into electric power which is utilized for operating the disposal plant and for charging storage batteries of the electric refuse collection trucks. It is understood that all of the power required for the collection of the refuse by these trucks is supplied by the incineration plant.

A separate cost and profit account is maintained for each of the various recovery processes and if a particular salvaging operation shows a financial loss it may be discontinued temporarily until favorable market conditions for the sale of the material salvaged are restored.

At the Montague Street works, in addition to the system above described, an organic waste utilization plant converts the city's animal and fish waste into feeding meals and fertilizers. This waste is passed through a system of closed digestors and grinders in such a manner that disagreeable odors are reduced to a minimum and appear to be confined entirely to one section of the plant. The products have a high commercial value, the annual turnover of the plant being approximately $50,000, about one-half of the products being exported. About 4,000 tons of animal and fish waste are disposed of annually in this way with a recovery of 1,000 tons of feeding meals and fertilizers and 80 tons of fats.

During the year ending March, 1926, Birmingham's department collected 260,332 long tons of refuse, of which amount 62% by weight was incinerated; 26% consisted of screenings; 8% represented cesspool contents taken to farms and sewers, and the remaining 4% was material treated at the organic waste recovery plant and salvaged as scrap metal and sundries. The gross expenditure for collection and the disposal of refuse was about $1,234,000 and the gross income about $257,000, or about 21% of the expenditure; giving a net cost of about $3.75 per long ton of refuse or approximately $1.00 per capita. The output of refuse per capita for the year was 0.27 long ton.

The Brookvale Road works makes a maximum use of mechanical appliances for reducing manual labor charges. During 1925 this plant treated 31,633 long tons of refuse at an operating cost of $1.30 per long ton and an income from salvaged material of 55c per long ton; leaving a difference or net cost of 75c per long ton.

Except for a rather noticeable amount of dust in certain rooms, the sanitation of the entire disposal works was nearly perfect, and a constant effort is being made by the use of forced ventilation to reduce the dust hazard to a minimum. Officials of the department stated that, so far as can be determined, this dust has no measurably deleterious effect on the health of the workers. Odors are prevented by an efficient system of washing the flue gases rising from the incinerators; in fact, no perceptible odor was observable in the vicinity of any of the disposal works visited.

From both an economic and sanitary point of view, but especially the former, British practice at present appears to be considerably in advance of that found in the majority of American cities. A great deal of the progress made in that country has been due in part to the active stimulation given to the local authorities by the Ministry of Health, and in part to the fact that in a majority of British cities these matters are administered wholly by technical specialists in sanitary engineering whose positions and tenure of office are entirely removed from the exigencies of local politics.

Recent Legal Decisions

ASSIGNEE OF ROAD SUBCONTRACTOR CANNOT SUE ON MISSOURI STATUTORY CONTRACTOR'S BOND

A subcontractor for road work in Missouri can not assign his account or demand against the principal contractor and by the assignment confer on the assignee the right to maintain an action on the statutory contractor's bond. Under Mo. Rev. St. 1919 § 1041, it is the materialman or subcontractor who is given right to sue on the bond, and there is no statutory authority for a suit thereon by an assignee. Missouri State Highway Com. v. Coopers Const. Service Co. (Mo. App.), 286 S. W. 736.

PAVING ASSESSMENT CERTIFICATE HELD TO SHOW THAT ASSESSMENT WAS MADE AFTER COMPLETION OF IMPROVEMENT

A paving assessment certificate sued on by the contractor bore the date July 20, the work having been completed and accepted July 14. It recited the ordinance of July 20 and other proceedings for payment of the assessment for the work done under a contract dated October 25 in the previous year. It was held that the certificate was not void as showing upon its face that no assessment had been made until after the completion of the improvement. City of Huntsville, Texas Civil Appeals, 286 S. W. 305.

IMPROVEMENT DISTRICT NOT LIABLE FOR SUBCONTRACTOR'S LOSS OF PROFITS BY CESSATION OF WORK

In consenting to the subletting of a portion of road construction work, the road improvement district assumes no contractual relation with the subcontractor which renders it liable to the latter for any profits it might have made by the performance of the contract after the road district has ordered the cessation of the work. Road Improvement Dist. No. 1 v. Mobley Const. Co., 286 S. W. 878.

CITY CANNOT PRUCHASE PAVING CERTIFICATES UNDER TEXAS STATUTE

The Texas Court of Civil Appeal holds, Watson v. City of Center, 286 S. W. 859, that a city has no implied right under Texas Rev. St. 1911, art. 1006, to purchase paving certificates from the paving contractor, nor is it authorized to do so by article 1011, authorizing it to make improvement certificates assignable. In any event it could only do so by ordinance or resolution and not by mere verbal motion at a meeting.

MATERIALMAN'S RIGHT TO RECOVER ON PUBLIC CONTRACTOR'S BOND—BOND MUST CONFORM TO STATUTE

A statutory bond is one that either literally or substantially meets the requirements of the statute. The Missouri statute requires a public contractor's bond "conditioned for the payment of material used in such work and for all labor performed in such work, whether by subcontractor or otherwise." A bond not even conditioned for the performance of the contract, but only to save the city harmless from pecuniary loss resulting from a breach of the contract on the part of the contractor, was held not a statutory bond, and gave the materialman no right to recover thereon. Southern Surety Co. v. United States Cast Iron Pipe & Foundry Co., C. C. A., Eighth Circuit, 13 Fed. (2), 833.

ASSENT TO ALTERATIONS IN CONSTRUCTION CONTRACT AS AFFECTING SURETY'S LIABILITY

Where a construction contract gives the contracting parties the right to make any alterations or changes in the terms of the contract and the nature of the work to be done, any changes made will not release the surety. Employers' Casualty Co. v. Irene Independent School Dist., Texas Civil Appeals, 286 S. W. 539.

STATUTORY LIMITATION OF TIME FOR ACTION BY MATERIALMEN ON PUBLIC CONTRACTOR'S BOND

The Texas Court of Civil Appeals holds, Van Zandt v. Desdemona Independent School Dist., 283 S. W. 626, that, a surety of a contractor for a school district being liable to materialmen by virtue of the state statute requiring a contractor's bond for the protection of the materialmen, their cause of action is on the statute and not at common law on the provisions of the bond, and the one year limitation prescribed by the Texas statute applies to their action.

"CONSTRUCTION" OF ROAD DOES NOT INCLUDE SELECTION OF ROUTE

The Missouri Supreme Court holds, State ex rel. St. Louis County v. State Highway Commission, 286 S. W. 1, that "constructed" as used in the Centennial Road Law providing that "refund roads" shall be "constructed under state supervision" means that the constituent parts are put together in their proper place and order and does not include power to select routes, which rests with the county authorities, under sections 29 and 33 of the statute.

ORDINANCE MAY BE A CONTRACT ORDINANCE OR AN OFFER TO RECEIVE PROPOSALS FOR A CONTRACT —MEANING OF "ESTIMATE OF THE COST"

A notice to contractors for the letting of a contract may be so worded as to require but an acceptance to constitute an enforceable legal agreement. On the other hand, the proposal may be nothing more than an invitation to negotiate.

An ordinance providing for the construction of a sewer and for the letting of the contract, directing advertisement for bids and requiring the bidder to file a certified check as a guarantee that if he should prove to be the successful bidder he would enter into a contract within ten days after acceptance of his bid, and reserving the right to reject any or all bids, incorporated in a notice to contractors, was held not to offer a contract, but to offer to receive proposals for a contract. A subsequent ordinance letting the contract to a successful bidder and his acceptance constituted the contract.

The phrase "estimate of the cost" in the statement in the contract ordinance that the successful bid was at a price not exceeding the estimate of the cost filed by the street commissioner and city en-

gineer was defined as an estimate of the total actual cost of the work. No reference being made to individual items of labor and materials, the contract was held to be a lump sum contract, and not one based on unit prices. City of Washington v. Mueller (Mo. App.), 287 S. W. 856.

ORDINANCE PLACING LIMIT ON COST OF SEWER CONSTRUCTION

An ordinance relating to the construction of a sewer, prohibiting the award of a contract therefor at a sum in excess of the city engineer's estimate of the total cost, no statute prohibiting a provision in an ordinance by a city of that class that the city council shall not award a contract for a greater sum than the estimate. Tax bills for the work would be invalid in so far as they were in excess of the estimated amount. City of Washington v. Mueller (Mo. App.), 287 S. W. 856.

ACTION AGAINST STATE HIGHWAY COMMISSION MUST BE BY CONSENT

The New Mexico Supreme Court holds, Looney v. Stryker, 249 Pac. 112, that injunction will not lie against the state highway commission and the members thereof, the state highway engineer, the state auditor and the state treasurer, to restrain them from paying moneys due a party contracting with the state, pending the efforts of a creditor of such contractor to procure a judgment at law in order that he may summon such state officials as garnishees, because it is in effect, an action against the state. No one can sue the state except by its own consent; and when he avails himself of this consent, he must pursue the remedy which the law has provided.

CITY MAY PROVIDE IN PUBLIC WORKS CONTRACT FOR RETENTION OF MONEY TO PAY LABORERS AND MATERIALMEN

A contract for the construction of a sewer contained a provision to the effect that, if the contractor failed to pay the laborers employed upon, or for materials used in, the work, the city might, at its option, withhold from the moneys due or to become due to the contractor, the necessary amounts to pay the same, and might pay the same, and deduct the amount from the final or other estimate due the contractor. The Utah Supreme Court holds, Salt Lake City v. O'Connor, 249 Pac. 810, that, although this stipulation was not required by law, it was proper and within the power of the city to make.

EVIDENCE AS TO AMOUNT OF WORK DONE UNDER GRADING CONTRACT

In an action for the balance of a contract price for grading a highway entered into with the principal contractor for the construction of the road, the grading contractor having ceased work with the consent of the road contractor, it was held that the engineer's estimates showing the amount of work completed at different dates were admissable in evidence although part of the work disclosed by them was performed after the plaintiff had ceased to work under the contract. Witnesses whose testimony was based on their observation of the work and not on measurements or calculations were held qualified to testify concerning the amount of work done, where they showed that they were acquainted with excavation work on public highways, although their judgment might not have been as accurate as if it had been based on measurements or calculations. Reynolds v. Stimson, Kansas Supreme Court, 247 Pac. 847.

INTEREST ON CLAIMS AGAINST COUNTY FOR ROAD WORK

The California District Court of Appeal holds, Palmer v. Shasta County, 245 Pac. 777, that interest does not begin to run upon claims against a county such as for a balance due on a contract for the construction of an approach to a bridge until the date of entry of judgment in an action therefor.

SUIT TO SET ASIDE ESTIMATE OF WORK DONE ON ROAD CONTRACT—RIGHT TO INTEREST ON AMOUNT DUE

The Oregon Supreme Court holds, North Pacific Const. Co. v. Wallowa County, 249 Pac. 1100, that a suit may be maintained to set aside the final estimate of the work done on a road contract and of the amount to be paid, although the contract made the engineer's estimates and decisions final and binding upon the parties. When the county's award was held to be inadequate, the contractor was held entitled, under Oregon Laws § 7988 to interest at 6 per cent. on the amount that ought to have been paid to it from 35 days after the filing of the award.

IRREGULAR LEVY OF PAVING ASSESSMENT NO DEFENSE TO CONTRACTOR'S ACTION FOR PAYMENT

The Indiana Supreme Court holds, Town of Dublin v. State ex rel. Fitzpatrick, 152 N. E. 812, that where a levy for a local paving improvement has been made and paid without objection and is in the city treasury, the mere fact that the levy was irregularly made and in part was against property not subject to assessment for that purpose is no defense to the contractor's action of mandamus to compel payment of the balance due for the paving, where it does not appear that the irregular levy produced an unjust result, or that anybody who paid the assessment did so under circumstances entitling him to a refund of his money or any of it in case a proper levy should be regularly made, or is complaining of what was done.

ROAD CONTRACTOR HELD NOT ENTITLED, UNDER CONTRACT, TO PAY FOR OVERBREAKAGE DUE TO BLASTING

In an action for a balance claimed to be due under a state highway construction contract the contractors claimed they had moved 42,404.2 cubic yards more material than they had been paid for. The question in the case was whether the removal of this excess was the removal of overbreak due to blasting, which the contractors were obligated to remove at their own expense. The specifications provided that "in solid rock excavation overbreaks due to blasting will be removed by the contractor at his own expense." The contractor's contention that they should be entitled to pay for the overbreakage due to blasting when that was not due to their negligence or fault was not sustained, since such a construction would require the reading into the contract of a condition qualification not contained therein. Porter v. State, Washington Supreme Court, 250 Pac. 449.

NEWS OF THE SOCIETIES

Aug. 16-19—INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Annual convention at Salt Lake City, Utah.

Sept. 13-15—INTERNATIONAL CITY MANAGERS ASS'N. Fourteenth Annual Convention at Dubuque, Ia.

Sept. 13-16—NEW ENGLAND WATER WORKS ASSOCIATION. Annual convention, Boston, Mass.

Sept. 15-16—CENTRAL STATES SECTION, AM. WATER WORKS ASS'N. Annual meeting at Akron, O.

Sept. 27-29 — CANADIAN GOOD ROADS ASSOCIATION. Fourth annual convention at Niagara Falls, Ontario.

Sept. 26-Oct. 1 — SAFETY CONGRESS, Sixteenth annual convention at Hotel Stevens, Chicago, Ill.

October 3—AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS: Annual meeting at Denver, Colo.

Oct. 5-8—CALIFORNIA SECTION, AM. WATER WORKS ASS'N. Meeting at San Jose.

Oct. 10—SOUTH WEST WATER WORKS ASS'N. Meeting at Hot Springs Ark.

Oct. 12-14—AM. SOCIETY OF CIVIL ENGINEERS. Fall meeting at Columbus, O.

Oct. 17-21—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual convention at Columbus, O.

Nov. 7-9—NORTH CAROLINA SECTION, AMERICAN WATER WORKS ASSOCIATION. Meeting at Durham, N. C.

Nov. 7-9—NORTH CAROLINA SECTION, AM. WATER WORKS ASS'N. Meeting at Durham, N. C.

Nov. 14-18—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Thirty-third annual convention at Dallas, Tex.

Nov. 28-Dec. 2—ASPHALT PAVING CONFERENCE. Sixth annual conference at Atlanta, Ga.

Dec. 1-2—HIGHWAY RESEARCH BOARD, NAT'L RESEARCH COUNCIL. Annual meeting at Washington, D. C.

Dec. 7-8—NATIONAL RIVERS AND HARBORS CONGRESS. Annual convention at Washington, D. C.

Jan. 9-10—INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS. Annual convention at Detroit, Mich.

Jan. 9-14—AMERICAN ROAD BUILDERS' ASSOCIATION. Annual convention and road show at Cleveland, O.

NEBRASKA CHAPTER, A. G. C.

The Nebraska chapter of the Associated General Contractors has been formed with the following officers: President, E. W. Kelterman; vice-presidents, Frank J. Moran, J. Q. Hossack, and Glen A. Smith; treasurer, W. G. Johnson; secretary, R. O. Green. Members of the executive board were elected as follows: Bridge Division: Glen A. Smith, one-year term; J. Q. Hossack, two-year term; W. G. Johnson, three-year term. Paving Division: Frank J. Moran, one-year term; J. N. Ball, two-year term; George Abel, three-year term. Grading Division: Wm. McGreer, one-year term; J. J. Lamoreaux, two-year term; E. W. Kelterman, three-year term.

ARKANSAS CHAPTER, A. G. C.

At the recent meeting of this chapter, officers were re-elected as follows: L. J. N. Keliher, president; George Harvey, vice-president at large; C. A. Miller, H. C. McCain, and C. E. Philpot, standing vice-presidents; L. L. McEachin, secretary-treasurer.

COUNTY HIGHWAY OFFICIALS ASSOCIATION

The American Road Builders Association has just completed the organization of a national County Highway Officials Association, a body of local road officials representing each of the 3,070 counties in the United States. The new organization will function similarly to the American Association of State Highway Officials, and will be known as a division of the American Road Builders Association. As its annual convention and road show, the County Highway Officials will have the advantage of the annual sessions of its parent organization.

The organization meeting was held at Washington on June 17, at which time a constitution was adopted and officials elected. Thomas J. Wasser, supervising engineer of the Board of Chosen Freeholders, Jersey City, N. J., was elected first president. Four regional vice-presidents were elected—Charles E. Grubb, Wilmington, county engineer of Newcastle County, Del.; Edward W. Hines, Detroit, road commissioner of Wayne County, Mich.; John Kirkpatrick, county judge, Wayne County (Benton), Kansas; and Stanley Abel, county supervisor, Taft, Cal.

The constitution adopted resembles somewhat the code used by the American Association of State Highway Officials, and sets forth the purposes of the new association as those of standardization of county road building, maintenance and finance methods, dissemination and exchange of road information, and the stimulation of local road construction.

The need for a national organization of this sort has long been felt. With 3,070 separate political sub-divisions constructing and maintaining highways without technical intercourse or standardization of methods, the waste of county or township funds has been inevitable, the expenditures under local agencies being approximately the same as those supervised by the state departments. The roads affected, although important to the immediate districts in which they lie, do not handle sufficient traffic to justify the construction of the more expensive types used on state highways; but counties need technical standards of grading, gravelling, surfacing or otherwise improving the local road.

The new association will start work immediately. Contact men will be appointed in each county of the United States, and report to various committees that will be formed by the present group of officials. The first reports will be delivered on County Officials' Day at the Annual Convention of the American Road Builders' Association.

The committees to be appointed are those on Survey and Plans, Road Type Selection, Design, Contracts and Specifications, County Highway Construction, County Highway Maintenance, Bridges and Culverts, Materials and Tests, County Highway Legislation, County Administration, Standardization of Accounts, Construction and Maintenance Equipment, Publications, County Highway Finance, Traffic, Publicity and Special Committees.

In addition to the president and regional vice-presidents, the following directors were elected:

For one year: Charles W. Deterding, county engineer, Sacramento County, Sacramento, Cal.; Jerry R. Zmunt, county commissioner, Cuyahoga County, Cleveland, Ohio; J. T. Bullen, parish engineer, Caddo Parish, Shreveport, La.; Merl Breese, county engineer, Luzerne County, Wilkes-Barre, Pa.; R. B. Preston, county engineer Norfolk County, Portsmouth, Va.; and J. A. Bromley, county road engineer, Anne Arundel County, Annapolis, Md.

For two years: J. L. Jones, Los Angeles County, Los Angeles, Cal.; B. W. Davis, county engineer, Nash County, Nashville, N. C.; Otto Hess, county commissioner, Harris County, Houston, Tex.; S. A. Green, roads engineer, Baltimore County, Townson, Md.; R. C. Hill, county engineer, Sussex County, Georgetown, Del.; T. D. Pendegrass, superintendent of roads, Durham, N. C.; and T. H. Baldwin, county engineer, Laramie County, Cheyenne, Wyo.

For three years: H. B. Keasby, county engineer, Salem County, N. J.; E. A. Griffith, chief engineer of roads, Allegheny County, Pittsburgh, Pa.; Charles A. Brown, chief engineer, Orange County, Orlando, Florida; C. F. Winkler, probate judge, Greenville, Alabama; Thos. H Madden, county commissioner, Trumbull County, Warren, Ohio; George A. Quinlan, county superintendent of highways, Cook County, Chicago, Ill.; and E. C. Gwillim, county surveyor, Sheridan County, Sheridan, Wyo.

AMERICAN SOCIETY OF CIVIL ENGINEERS

The annual convention of the American Society of Civil Engineers was held in Denver, Colo., July 12 to 16. Meetings were held by the sections on irrigation, surveying and mapping, highways, and city planning. Constitutional amendments regarding admission requirements were considered, and will be referred to the membership by letter ballot. A meeting of the Board of Directors, at which nearly all of the directors were present, was held previous to the general meeting. About 200 applications for membership were acted on; a committee was appointed to consider a program of research into the behavior of soils, which committee consisted of Charles R. Gow, Boston, A. N. Talbot, University of Illinois, and Allen Hazen, N. Y.

(Continued on page 46)

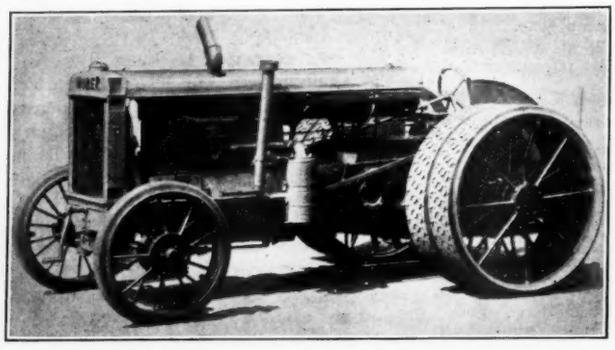
New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

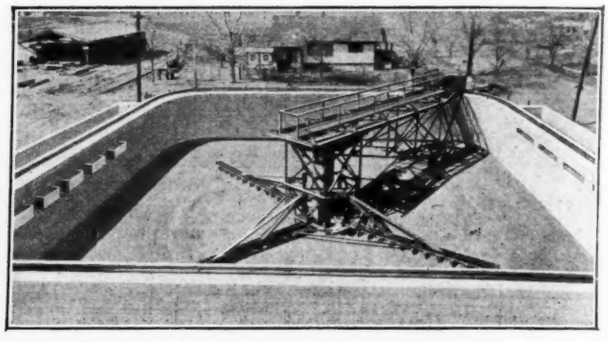
HUBER INDUSTRIAL TRACTOR

The Huber Manufacturing Co., Marion, O., has just brought out the Huber Super Four Industrial Tractor, which is stated to be the heaviest wheel tractor equipped with rubber treads. It is suitable for freighting, road building, road maintenance and general industrial service where the work to be done and the loads to be handled are beyond the capacity of the smaller industrial tractors now available.

This tractor is made in three sizes, delivering, respectively, 22, 30, and 40 h.p. at the draw-bar. It is provided with a low speed for heavy hauling, and a high speed for long distance freighting. The transmission is enclosed, and runs in oil; the tractor is equipped throughout with roller bearings. Power take-off and belt pulley equipment make it suitable for all classes of belt and draw bar work.



HUBER SUPER FOUR INDUSTRIAL TRACTOR



DORR TRACTION CLARIFIER

BELT CONVEYOR IDLER

Link-Belt Company, Chicago, announces a new anti-friction belt conveyor idler and return rolls which is said to embody many salient features of advantage in design which are the result of years of study and research.

Bearings are Timken tapered roller bearing type, which are totally encased within the roll hub. The outstanding feature of the idler is the absolute protection afforded by a labyrinth grease seal, mounted in a grease cap which also serves as an outboard reservoir and lubricates the bearing on the outside as well as on the inside, especially when the roll is on an incline. This, in turn, is protected by a deflector plate which deflects dirt, dust, grit or any foreign material away from the bearings and grease seal, and will not permit the washing of the grease away from the labyrinth.

The rolls are mounted on a self-cleaning "T" base. All rolls are interchangeable, being capable of serving in any of the three positions. The entire frame is riveted, and is without bolt or nut to work loose or to come out of adjustment.

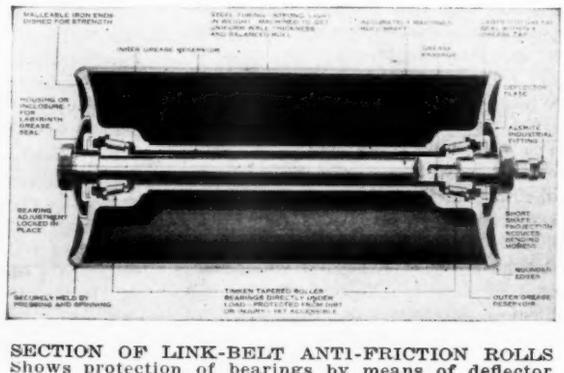
Another advantage claimed is the close working tolerance to which all parts are built, closer than have ever been attempted in belt conveyor history. The use of specially-constructed manufacturing tools secures alignment of bearings and a well-balanced, concentrically running roll. Special care is exercised in the machine of the roll shell, to obtain uniformity of thickness of the wall, into which the machined heads are pressed and securely held in place by spinning. The heads are dished for rigidity and strength, and the entire construction is such as results in maximum strength.

It is claimed also that the superior design and construction of the roll make it practicable to vary the characteristics of the material used for the roll shell. A special iron has been developed for use in coke plants, which resists the corrosive action of sulphuric fumes and the abrasiveness of coke dust; and rolls have been granitized for the handling of certain types of material such as salt, alkali and various other materials that cause incrustation, pitting and rusting of ordinary steel or iron.

The idler rolls are supported in malleable iron brackets having a large bearing surface for supporting them, and they are not dependent upon the use of slots. The brackets are so constructed as to support the ends of two adjacent rolls, thus obtaining perfect alignment of rolls. Roll shafts are supported at both ends close to the rolls, without overhang, thus reducing the bending moment to a minimum. Rolls are spaced far enough apart to permit convenient removal from the frame by simply lifting them out without the use of any tools.

Idler rolls are made in various standard lengths, and they are furnished in combinations to suit standard belt widths. The end stands are securely riveted to the "T" iron base, and are spread at the foot to present a rigid support for the Idler.

These idlers are made at the Ewart plant of the Link-Belt Company, Indianapolis, in a building especially designed for their exclusive manufacture.

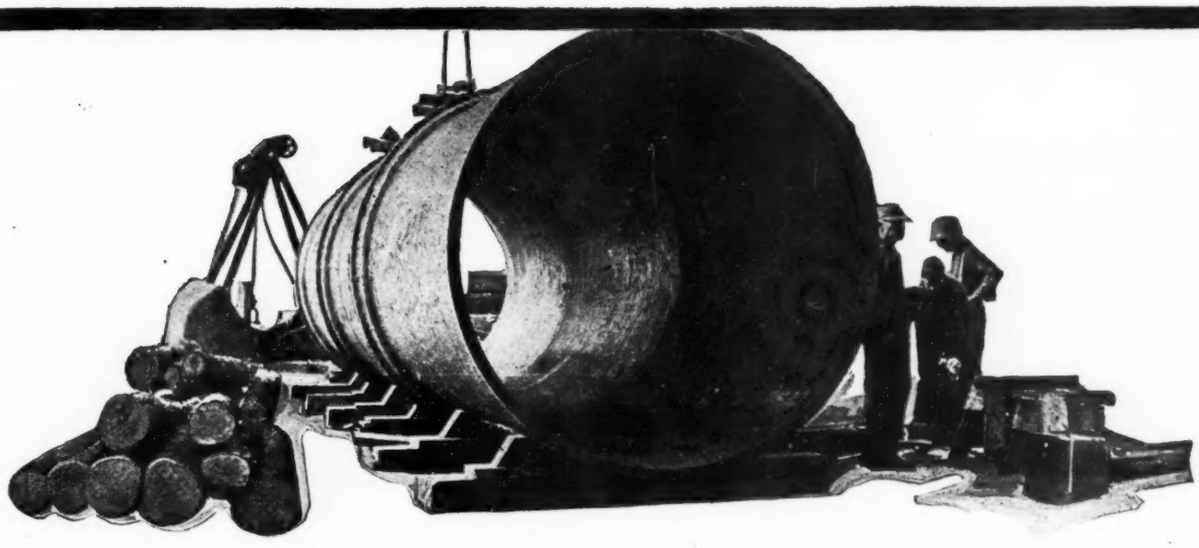


SECTION OF LINK-BELT ANTI-FRICTION ROLLS
Shows protection of bearings by means of deflector plate and labyrinth grease seal.

DORR TRACTION CLARIFIER

The Dorr Co., N. Y., have developed the Dorr traction clarifier which is an improvement over the usual type of clarifier. It operates in a square concrete tank, built with a combination sloping and flat bottom. The sloping bottom is circular around the center, and the flat portion extends from the edge of the slope to the sides of the tank. The mechanism consists of two sets of raking arms, one for the sloping and one for the flat bottom. The drive unit, consisting of traction wheel, reduction gears, and motor, travels around the periphery of the tank on a steel rail, and is connected to the center scrapers by a driving truss, which carries the scrapers for the flat bottom. The driving truss extends beyond the center column a distance sufficient to allow the outer end to travel out to the corners of the tank and still be supported at the center. All electrical equipment is entirely covered, there are no submerged bearings in wearing parts, and no superstructure over the tank. This arrangement gives a strong and rigid construction with a smooth and positive drive.

Boston selected 84" cast iron pipe



Where permanence and low maintenance cost are essential

Cast Iron Pipe is chosen!

United States Cast Iron Pipe & Foundry Co.
Makers of deLavaud
Centrifugal Cast Iron Pipe
PATENTED

Municipal, industrial or construction engineers are invited to write for literature covering cast iron pipe and fittings for all purposes.

United States Cast Iron Pipe and Foundry Company

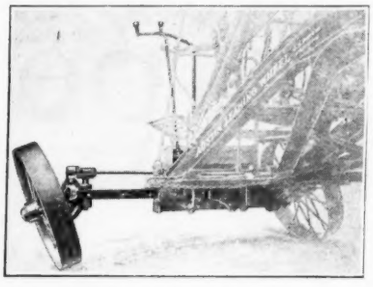
SALES OFFICES

Philadelphia: 1421 Chestnut St.
Chicago: 122 So. Michigan Blvd.
Birmingham: 1st Ave. & 20th St.
Buffalo: 957 East Ferry Street
Cleveland: 1150 East 26th Street
New York: 71 Broadway
San Francisco: 3rd & Market Sts.
Pittsburgh: 6th & Smithfield Sts.
Dallas: Akard & Commerce Sts.
Kansas City: 13th & Locust Sts.
Minneapolis: 6th St. & Hennepin Ave.

General Offices:
Burlington, New Jersey

AUSTIN-WESTERN TELESCOPIC AXLE LEANING WHEEL GRADER

The Austin-Western Road Machinery Co., Chicago, Ill., has now combined, with its leaning wheel grader, the telescopic rear axle used for many years past on Austin-Western straight wheel graders. The principal advantage of the telescopic axle, it is stated, is that it enables the operator to set his blade so that it will do the most work, and then place the rear wheels where they are out of the way of the furrow. It is not necessary to run with one rear wheel in the loose dirt, or with the axle dragging



TELESCOPIC AXLE WITH LEANING WHEEL

in it. It is also possible, in many places, to carry the ditch cuts around culverts, when the axle is shortened. The telescopic axle is also claimed to be superior in new road construction on hillsides, and in working on narrow roads where traffic must be maintained. A heavy rear axle, and the ability to extend the axle when necessary, are frequently of much value in construction work.

FIVE NEW SULLIVAN DRILLS

The Sullivan Machinery Co., Chicago, Ill., has brought out five new types of drills of various sizes. The T-3 is a 165-pound machine for column, tripod, or quarry bar mounting. It handles 1¼ inch round hollow steel to the customary needed depths. An important feature is the ability of this machine to work satisfactorily with either low pressures, such as often obtain in mining, or under the high air pressures required in modern heavy tunneling work, and to resist freezing troubles in damp air and cold conditions.

The L-5 is a medium weight sinker intended as an all-around down hole machine, hand held. It is designed to handle 1-inch steel, though under favorable conditions 1⅛-inch steel can be used. A speed of 10 to 12 inches per minutes has been attained repeatedly. It is equipped with a blowing device; for deep drilling a water tube type is available, but ordinarily water is poured in at the collar of the hole when necessary. The L-5 weighs 75 pounds and takes 1-inch air hose.

The L-7 rotator is a 45-pound general purpose light rock drill, suitable for the general run of light rock drilling in quarries, mines and on construction jobs, ranging from block-holing boulders to average shaft sinking and down-hole drilling. The L-7 uses ⅞-inch hollow steel to ordinary depths, is equipped with a blower and takes ¾-inch air hose. There is but one lubricating point.

The H-8 is an auger drill, weighing only 39 pounds so that it may be held horizontal or upward without undue fatigue. The H-8 is especially designed for soft ore drilling. In soft ground drilling, the L-8, soft ground rotator is recommended, especially where the L-7 blow is too heavy. The L-8 weighs 39 pounds and is similar to the auger rotator in design. It may be equipped with water tube and water hose. Rotation of the bit is on the rearward stroke.

SULLIVAN L7 ROTATOR ON ROCK WORK

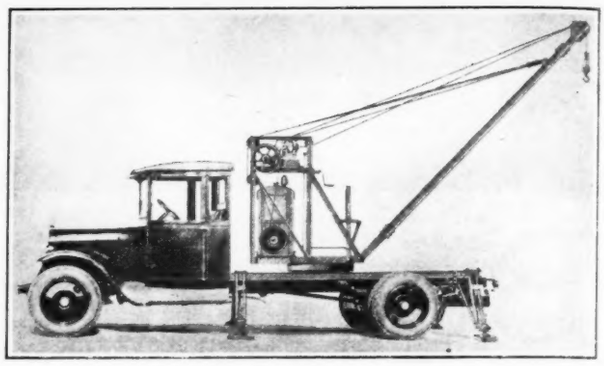
L5; A 75-LB. HAND DRILL FOR SHAFT SINKING, ETC.

H8 AUGER ROTATOR

WALTER SNOW FIGHTERS

The Walter Motor Truck Co., Inc., Long Island City, N. Y., manufactures the Walter Snow Fighters, which are fast and powerful four-wheel drive tractor trucks, with power, it is claimed, to push through deep snow and cover long patrols. An exclusive feature is the Walter automatic lock differential, which, while allowing free differential speed on turns, locks when adhesion is lacking on one or more of the wheels and revolves the four drive wheels at the same speeds. Thus if one wheel has traction, the machine will move.

The motors are of 80 to 100 horsepower, and 5 gear ratios are provided, giving speeds of 1 to 25 miles per hour, the gear ratios being 1:85 in low and 1 to 8½ in high. The carrying capacity is 4½ to 7½ tons.



SQUIER-RIX TRUCK CRANE

RIX TRUCK CRANE

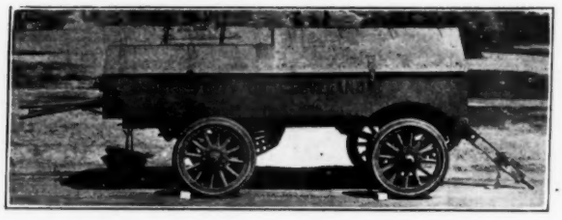
The Squier-Rix Company, Milwaukee, Wis., has recently brought out an addition to its line of tractor cranes, namely, a truck crane for mounting on comparatively light trucks. This truck crane is of substantial construction and is designed to fit the truck without the necessity of drilling holes or in any way altering its mechanical construction. The hoisting power is a 4-cylinder, governor-controlled engine with high tension magneto, belt driven from engine to hoisting mechanism. The hoisting mechanism is the standard Rix transmission with 8-inch by 8-inch drum of 100 foot cable capacity. It has a double clutch drive with single lever control, and the hoisting mechanism is equipped with an automatic load brake.

The swing of the boom is by power controlled by one lever. Power is taken from the hoist motor; the boom hoist is a hand operated worm geared safety winch. A special feature of the crane, which makes possible the use of comparatively light trucks, is the four adjustable jack outriggers which are fastened to the hoist frame. These not only insure stability on swinging loads, but also relieve the truck frame of strains and stresses. The hoisting speed of the hook is 32½ feet per minute. The swinging speed can be varied. Standard boom length is 15 feet, and the swinging radius is 360 degrees. A sheet metal cab is built over the transmission and motor frame.

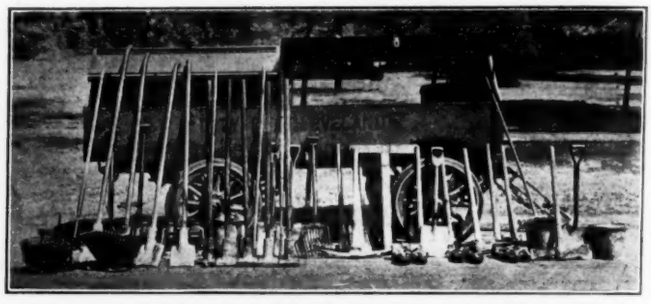
The crane is detached easily from the truck and may be used as a yard derrick. It can be used for all material handling operations for which truck cranes are suited, while the ability to use it as a yard derrick as well, makes this outfit, which is normally mounted on medium weight (2 to 2½ ton) trucks, a very economical one, both in first cost and in operation.

FOX TOOL HEATER

The Fox Tool Heater, 2 Lafayette St., New York, is designed to keep at the proper temperature at all times, tools used in street repair work. It also provides a very efficient tool carrier, since a compartment is provided in which tools may be stored safely and locked. Since the operational features of the heating device are very simple, a minimum of attention is necessary, and the blaze may be turned up or down as required to keep the tools at the proper temperature. The outfit can be moved easily and therefore can be kept in the location most convenient to the work; and since the heater is also the tool carrier, the danger of tools being lost or scattered over the job is minimized. In addition to its ability to keep the tools hot, and to carry lanterns, shoes, boots, tools, and other necessary equipment, there are facilities for heating asphalt cement for street repair, and for doing other necessary street work.



HEATER LOCKED WITH TOOLS INSIDE



TOOLS REMOVED FROM HEATER

MODEL 111-A INDIANA ROAD BUILDER

The Indiana Truck Corporation, Marion, Ind., has just brought out the Model 111-A Road Builder, which is a motor truck specially designed for highway construction. The body capacity is 1½ cubic yards, and the wheel base is 130 inches. The weight is 5,150 pounds. Standard equipment is pneumatic front and dual pneumatic rear, all 33x5. The speed is 30 miles per hour, and the truck has a turning radius of 24 feet, making it especially valuable in close quarters. The engine is 4-cylinder, with 5-inch stroke and 4-inch bore, and has full force system of oiling.

RAPID DRAINAGE PIPE

Walker Cement Products, Little Ferry, N. J., is the sole manufacturer in the United States of Rapid Drainage pipe, which presents a new principle in drain pipe construction. This pipe is constructed of cement and small stone in such a fashion that it is porous throughout its entire surface. There are no open joints to become clogged. The ends are concave and convex, which fit closely together, insuring permanent alinement under usual conditions of use. The strength is claimed to be sufficient for all ordinary loading, having a crushing strength per foot of length of 1,350 pounds for 5½-inch pipe (inside diameter), according to the A. S. T. M. specifications. Rapid drainage pipe is also claimed to be frost-proof as its structure prevents any appreciable expansion or contraction. Tests have shown the 5½-inch pipe to have an infiltration rate of 6.95 gallons per minute. This pipe is made in sizes with inside diameters of 3½, 5½, and 8 inches. It is claimed to be especially suited to municipal and highway use.

INDUSTRIAL NOTES

FOOS ENGINE CO. OFFICERS

J. F. Baker has been elected president, and M. E. Baker, secretary and treasurer, of the Foos Engine Co., Springfield, O., formerly the Foos Gas Engine Co. Ray C. Burrus has been appointed sales manager. W. W. Schettler, chief engineer, and Geo. F. Noltoin, mechanical engineer.

PERSONNEL CHANGES OF THE TRACKSON CO.

H. D. Van Doorn, formerly Manager of Distribution, has been made Assistant Manager, the Trackson Co. L. E. Daner, formerly Assistant Sales Manager, has been promoted to the position of Sales Manager. C. W. O'Connor, Advertising Manager, has resigned.

INGERSOLL-RAND OPENS NEW BRANCH

In order to provide better sales and service facilities for its customers in northern New Jersey and certain adjacent counties of New York State, Ingersoll-Rand Company has opened a Branch Office at 236 High St., Newark, N. J. F. K. Armstrong, formerly connected with the Company's New York Sales Branch, has been appointed Manager.

AM. CAST IRON PIPE CO. CHANGES

C. A. Carlisle has succeeded R. R. Silver as Editor of *Pipe Progress*, the publication of the American Cast Iron Pipe Co., Birmingham, Ala. Joseph J. Swenson succeeds Paul Ivy as general sales manager, and Lester Long succeeds Mr. Swenson as manager of the Los Angeles office.

BUHL CO. ASS'T SALES MANAGER

W. J. Henry, for the past five years with the P. & H. organization, has been made assistant sales manager of the Buhl Company of Chicago. He will have direct charge of all Buhl agencies. Mr. Henry is a graduate of Rensselaer Polytechnic institute and was for a time engineer in the New York State Highway Department.

J. V. N. DORR HONORED

In consideration of the important contributions to the metallurgical and chemical industries made by J. V. N. Dorr, president of The Dorr Company, Rutgers University conferred upon him the degree of Doctor of Science at its Commencement on June 11th.

AMERICAN SURETY CO.

The Albany Service Bureau of the American Surety Co., of New York, is now known as the American Surety Service Bureau, and is located at 100 State Street, Albany.

PERSONNEL CHANGES, CYCLONE FENCE CO.

J. H. Kinney has been appointed general manager of the Cyclone Fence Co., Waukegan, Ill., succeeding J. W. Meaker, who resigned to become president of the Bates Valve Bag Co. of Chicago. Other appointments include: H. G. Chapman, general sales manager; A. W. Kirkham, treasurer; W. M. Jensen, assistant treasurer; R. E. Pinniger, Eastern sales manager; S. W. Burr, sales manager at Cleveland, O.

OREGON REPRESENTATIVE OF THE GALION LINE

The Willamette Equipment Company of Portland, Oregon, is now authorized representative of the Galion Iron Works and Mfg. Co., for the state of Oregon, and will handle the complete Galion line of road graders, road rollers, motor graders and other road building and maintenance equipment, stocking this equipment at Portland.

DARNALL PATENT DECISION AFFIRMED

On July 6 the U. S. Circuit Court of Appeals in New York City affirmed without opinion the decision of Judge Hazel, rendered on January 29 and referred to in Public Works for March, finding that the Village of Leroy, N. Y., had infringed the Darnall patent for chlorine sterilization owned by Wallace & Tiernan Co., Inc., and that the Paradon Engineering Co. was guilty of contributory infringement.

PERSONALS

W. A. McCalla, formerly State highway engineer of Alabama, and R. L. Kenan, of Selma, Ala., have formed a partnership, and opened consulting engineering offices in Montgomery, Ala.

H. W. Crawford has been appointed city engineer of Ponca City, Okla., succeeding E. A. Jones, who will open an office as consulting engineer at Enid, Okla.

C. D. Parsons, formerly of the Buffalo, N. Y., Department of Public Works, has opened a consulting engineering office in Orlando, Fla.

Donald C. McMillan, formerly field engineer with the Southern California Gas Co., has been appointed city engineer of Ventura, Calif.

A. B. Gladley, formerly city engineer of Marshfield, Ore., has been appointed city manager of Burbank, Calif.

William P. Gerhard, consulting sanitary engineer and author of many books on sanitary engineering subjects, died July 8, aged 72 years.

MUNICIPAL AND OTHER PUBLIC REPORTS

The Engineering Experiment Station, Iowa State College, Ames, Ia., has published the following research bulletins, copies of which will be sent free on request:

The chemical action of alkali on hydraulic cements is the subject of a 56 page illustrated bulletin (No. 74) Experiments were carried out on Portland cement and high alumina cement, using magnesium sulphate, magnesium chloride, sodium sulphate, sodium chloride and sodium bi-carbonate solutions. It was found that a magnesium sulphate solution had the greatest destructive action on concrete and next to that, sodium sulphate.

Bulletins No. 81 and No. 82 deal with the treatment of creamery wastes. No. 81, a 30 page bulletin by Max Levine, Geo. W. Burke and Clair S. Linton, deals with the purification of skim milk solutions on a lath filter and No. 82, a 32 page bulletin by Max Levine and Lulu Soppeland, deals with the proteolysis by bacteria isolated from creamery wastes. These bulletins are the third and fourth of a series published as a result of investigations conducted for the last several years.

Formulas for the transmission of wheel loads to culverts through various thicknesses of cover are included in bulletin 79, an 80 page illustrated bulletin entitled "Experimental Determinations of Static and Impact Loads Transmitted to Culverts." The bulletin is the result of a three-year highway research investigation conducted at Ames, Iowa, in cooperation with the United States Bureau of Public Roads.

A 44 page illustrated bulletin, No. 80, deals with concrete cradles for large pipe conduits. The research investigation was conducted at Ames, Iowa, in cooperation with the United States Bureau of Public Roads. This bulletin deals with the action and effectiveness of cradled concrete pipe from 24 in. to 80 in. in diameter. (See PUBLIC WORKS for July, page 251.)

Phototopographic Maps of Southeastern Alaska.—A considerable area in southeastern Alaska was mapped by airplanes last summer by the Navy Department in co-operation with the Geological Survey. A set of three pictures, consisting of one vertical and two oblique views, covers about 11 square miles, but because of this oblique method of photography, the prints cannot be joined together to form an undistorted mosaic. The middle pictures are about 5½ inches square. The oblique pictures are transformed or corrected so as to give them a uniform scale, and thus take a wedge-shaped form, about 4⅝x8¼x8½. The areas covered by these photographs overlap, but, as stated, cannot be used to give a continuous map that will join correctly. The prints are available through the Forest Service, Washington, D. C.

The Cost of Government, City of Detroit, 1927-1928. Detroit Bureau of Governmental Research. 20 pages.

Proceedings Fifth Annual Asphalt Paving Conference. The Asphalt Association, N. Y. 144 pp. Ill. Contains a complete record of all papers presented at the conference.

Convention Proceedings, 1927. *American Road Builders' Association.* 356 pp. Ill.

This contains the complete papers presented at the 24th annual convention held at Chicago Jan. 11-15, 1927, with discussions, committee reports, and list of exhibitors.

BOOK REVIEWS

Standards of the Hydraulic Society. C. H. Rohrbach, Sec'y, N. Y. 4th edition, 80 pages. Ill. 50c.

This edition is illustrated with charts, tables, drawings and half tones of pumps and pump parts and contains sections on definitions and values; extracts from pump test codes; a revised pump classification; description of types, parts and definitions pertaining to the several classes of pumps (reciprocating displacement, rotary displacement, centrifugal and deep well); instructions for installing and operating each type; a recommended contract form for use in the pump industry; data, tables, curves and formula, including pipe friction data for both water and oil and a comprehensive list of materials recommended for pumping different liquids.

Municipal Insurance. By Orin F. Nolting, secretary, Municipal Reference Bureau, The International City Managers' Ass'n, and the League of Kansas Municipalities. 62 pages. $1. (Three copies for $2.50).

This bulletin represents the facts, arranged in a readable form, collected in a survey covering the practices of cities in insuring their property. The discussion on hazards and risks of city property is of much interest, and a following statement regarding the practice of insuring city property is based on several studies covering a rather wide field. Methods of insurance, amount of insurance, and costs and losses are also discussed. There are complete appendices, including a bibliography on municipal insurance.

Practical Structural Design. By Ernest McCullough. Scientific Book Corp. 3rd edition. 416 pp., 224 ill. $4.

The third edition of this book is an enlarged and somewhat revised version of a practical treatise on the mechanics of materials and structural design. This book, which was prepared from material used largely in teaching in night schools, avoids complicated formulas; no calculus is used, and where algebra is necessary, examples are worked out. Two new chapters have been added, covering specifications, foundations, influence lines and methods of moments, and reinforced concrete.

TRADE PUBLICATIONS

Long Pipe Lines With Oxwelded Joints. The Linde Air Products Co., 32 pp. Ill. While this booklet is devoted primarily to accomplishments in the oil and gas industries, the results achieved are of equal interest and value to those engaged in the waterworks field. No cost data are given. The adaptation of the welding process to long pipe lines is shown by numerous illustrations.

CIVIL SERVICE EXAMINATIONS

ENGINEERING FIELD AID

Applications to Aug. 16. To fill vacancies in the field service of the U. S. Geological Survey. Entrance salaries $900 to $1,260. Duties include simple routine technical work incident to topographic and geodetic field surveying. Competitors will not be required to report for an assembled examination, but will be rated in their education, experience and fitness.

TOPOGRAPHIC DRAFTSMAN

Applications to Aug. 9. To fill grades of junior, assistant, topographic draftsman, and senior topographic draftsman. Entrance salaries, $1,320, $1,500, $1,680, and $1,860 respectively. Non-assembled examinations. Advancement after probationary period of 6 months depends upon increased usefulness, individual efficiency, and occurrence of vacancies.

PRINCIPAL ARCHITECTURAL AND STRUCTURAL STEEL DRAFTSMAN

Applications to Aug. 9. To fill vacancies in the lighthouse service, Department of Commerce, etc. Entrance salary $2,100. Duties include performance of difficult freehand drafting and supervision of draftsmen of lower grades. Non-assembled examination.